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ABSTRACT

This seventh annual report discusses the state of the environment and new or continuing efforts to improve it. The topics are treated in two parts. The first part discusses events of the past year and cites new legislation, court rulings, and other major developments affecting the environment. Part two focuses on conditions and trends by analyzing data to show environmental improvement or deterioration over the years. Chapters in part one of the report deal with pollution, land use and coastal zone management, natural resources, energy, international events, and economics. Chapters in part two explore the environmental consequences of energy technology, air quality, water quality, and environmental indicators. Current projects of the Council on Environmental Quality are included in the appendix. (CS)

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Environmental Quality

THE SEVENTH ANNUAL REPORT OF THE COUNCIL ON ENVIRONMENTAL QUALITY

ED149997

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Report on 1975 Public Hearings:
Environmental Effects and Conservation Aspects
of the Nonnuclear Energy Research, Development,
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Environmental Impact Statements:
An Analysis of Six Years' Experience
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THE SEVENTH ANNUAL REPORT OF THE
COUNCIL ON ENVIRONMENTAL QUALITY

ENVIRONMENTAL QUALITY—1976

September 1976

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THE PRESIDENT'S MESSAGE

To the Congress of the United States:

I am pleased to transmit to the Congress the Seventh Annual Report of the Council on Environmental Quality.

Two hundred years ago, the United States of America was comprised of 2.5 million people and nearly 1 million square miles of land. Our country seemed an indefinite expanse of natural resources.

Today, the United States of America encompasses over 3½ million square miles, and numbers 215 million people. Although we remain one of the most fortunate nations on Earth, our natural endowment is deteriorating.

The growth of our population and the expansion of American technolgy demonstrates that there are limitations to our natural riches. The industrial concept of man as master of an inexhaustible world for his convenience is giving way to an ecological concept of man as caretaker of limited resources that must be protected.

Since the adoption of the National Environmental Policy Act, Americans have made measurable progress in safeguarding, nurturing, and redeeming our natural heritage. Many other countries have joined in recognizing that misuse and irresponsible exploitation of the globe threaten the well-being of humanity. Yet, progress has been neither even nor universal.

A higher consciousness—even spiritual awareness—must evolve if humanity is to live in harmony with nature. We are grateful that the process of awakening has started.

In this first year of our third century, I am optimistic that growing American recognition of the respect and reverence that we must accord to Earth, water and air will light the way to a new era. We must and will pass on to future Americans the magnificent legacy of nature as well as our cherished heritage of political freedom.

GERALD R. FORD.

THE WHITE HOUSE

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
722 JACKSON PLACE, N. W.
WASHINGTON, D. C. 20006

LETTER OF TRANSMITTAL

THE PRESIDENT:

Sir: The Council on Environmental Quality herewith submits its seventh Annual Environmental Quality Report, September 1976, in accordance with Section 201 of the National Environmental Policy Act of 1969 (42 U.S.C. 4341).

Respectfully,

Russell W. Peterson

Russell W. Peterson
Chairman

John A. Busterud

John A. Busterud

Beatrice E. Willard

Beatrice E. Willard

PREFACE

This report differs from those of the past few years in noteworthy respects. Most obviously, it is shorter—roughly half the length of the 1975 Annual Report. One of the reasons for this brevity is the Council's decision that lengthy chapters on special topics—such as those on cancer in 1975 and on land use in 1974—should be issued separately throughout the year as individual publications. In addition, the format has been changed. Although the topics covered are similar to those in the past years, they are treated in two parts: "Events of the Past Year" cites new legislation, court rulings, and other major developments that affect the national and global environment; "Conditions and Trends" analyzes data to show environmental improvement or deterioration over the years.

The Council hopes that the new format will make this Annual Report more useful as a reference document and welcomes any comments or suggestions regarding it.

ABBREVIATIONS

AIA	Agency for International Development
ANCSA	Alaskan Native Claims Settlement Act
AQCR	Air Quality Control Region
AUM	Animal unit month
BLM	Bureau of Land Management
BOD	Biochemical oxygen demand
Btu	British thermal unit
CCD	Committee of the Conference on Disarmament
CCMS	Committee on the Challenges of Modern Society
CEC	Commission of European Communities
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CO	Carbon monoxide
CO_2	Carbon dioxide
CPI	Consumer Price Index
CPSC	Consumer Product Safety Commission
dB	Decibel
DDT	2,2-Bis(p-chlorophenyl)-1,1,1-trichloroethane
DES	Diethylstilbesterol
ECE	Economic Commission for Europe

ECLA	Economic Commission for Latin America
EDTA	Ethylene diamine triacetic acid
EPA	Environmental Protection Agency
ERDA	Energy Research and Development Administration
ESECA	Energy Supply and Environmental Coordination Act
FAA	Federal Aviation Administration
FAO	Food and Agriculture Organization
FBC	Fluidized bed combustion
FDA	Food and Drug Administration
FEA	Federal Energy Administration
FIA	Federal Insurance Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FPC	Federal Power Commission
FRES	Forest Range Environmental Study
FY	Fiscal Year
GAO	General Accounting Office
GEMS	Global Environmental Monitoring System
GNP	Gross National Product
Habitat	United Nations Conference on Human Settlements
HC	Hydrocarbon
HEW	Department of Health, Education, and Welfare
HUD	Department of Housing and Urban Development
IAEA	International Atomic Energy Agency
IMOS	Inadvertent Modification of the Stratosphere
IRS	International Referral System
LMFBR	Liquid Metal Fast Breeder Reactor
LNG	Liquefied natural gas
N	Nitrogen
NAAQS	National Ambient Air Quality Standard

NAS	National Academy of Sciences
NCI	National Cancer Institute
NCWQ	National Commission on Water Quality
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NIOSH	National Institute for Occupational Safety and Health
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxide
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NRA	National Recreation Area
NRC	Nuclear Regulatory Commission
NRDC	Natural Resources Defense Council
O_3	Ozone
OAS	Organization of American States
OCS	Outer Continental Shelf
OECD	Organisation for Economic Co-operation and Development
OMB	Office of Management and Budget
ORV	Offroad vehicle
OSHA	Occupational Safety and Health Administration
P	Phosphorus
PAHO	Pan American Health Organization
PCB	Polychlorinated biphenyl
ppb	Part per billion
ppm	Part per million
PSI	Pollutant Standards Index
qBtu	Quadrillion British thermal units
RD&D	Research, development, and demonstration
RPA	Forest and Rangeland Renewable Resources Planning Act

SBA	Small Business Administration
SEAM	Surface, Environment, and Mining
SO_2	Sulfur dioxide
SST	Supersonic transport
TCP	Transportation control plan
TLV	Threshold limit value
TSP	Total suspended particulates
UN	United Nations
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USDA	U.S. Department of Agriculture
WHO	World Health Organization
WMO	World Meteorological Organization
WPI	Wholesale Price Index
WRC	Water Resources Council

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Events Collage Photo Credits

(Top) Paper plant, U.S. Environmental Protection Agency—Documerica, Lee Lockwood. (Center left) Pesticide spraying, *Environment* Magazine, St. Louis, Mo. (Center right) SST, British Aircraft Corporation. (Bottom left) Strip mining, U.S. Department of the Interior, Bureau of Reclamation, Lyle C. Axthelon. (Bottom right) Wetlands, U.S. Department of the Interior, Sport Fisheries and Wildlife, Luther C. Goldman.

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(Top) Off Interstate 77 southwest of Brecksville, Ohio, U.S. Environmental Protection Agency—Documerica, Frank Aleksandrowicz. (Center left) Forest, U.S. Department of the Interior, Geological Survey. (Center right) Trailer town of Colstrip, Montana, Montana Department of Natural Resources and Conservation. (Bottom left) Coke plant on the Monongahela River, U.S. Environmental Protection Agency—Documerica, John Alexandrowicz. (Bottom right) Open copper pit mine in Arizona, U.S. Department of the Interior, Geological Survey.

EVENTS
1

I. EVENTS OF THE PAST YEAR

POLLUTION

AIR

The nation is midway between the two deadlines established by the 1970 amendments to the Clean Air Act: July 1, 1975, to attain primary ambient air quality standards for protecting public health; and July 1, 1977, to attain secondary ambient air quality standards for protecting public welfare. As indicated in Chapter II of this Annual Report, we have not yet attained the primary standards in many regions, and the energy shortage and the recession have increased the concern that we are attempting to do too much too fast. However, there have been some significant accomplishments, and some new problems have been recognized.

Amending the Clean Air Act

The major events of the past year involved attempts by Congress to amend the Clean Air Act. Five years of experience had demonstrated that the nation was not, in all cases, meeting the tight deadlines and stringent requirements imposed in the 1970 legislation. There was an apparent need to relax some of the more strict requirements of the earlier law, to toughen some requirements that Congress felt had not been implemented adequately, and to clarify some of the issues that were confused in the 1970 amendments or in subsequent court decisions.

There has been no final action on the amendments at the writing of this report, but the major issues are automobile emissions, nondeterioration in clean air regions, use of supplementary controls to meet ambient air quality standards, allowable growth in areas that do not meet ambient air quality standards, flexibility of regulatory authorities in implementing the legislation's requirements, and use of transportation control plans to attain ambient air quality standards.

Automobile Emissions. Concerns regarding extra fuel consumption and the high costs of auto emissions control beyond the 1975 standards have prompted proposed modifications that would relax the requirements of the 1970 amendments by extending the deadlines and perhaps raising the final nitrogen oxide standard. With current technology, the nitrogen oxide requirement imposes the greatest energy penalty and the greatest cost, with uncertain effects upon air quality. The success in abating automobile emissions to date is discussed later in this section, and Table I-1 summarizes some of the specific proposals made for amending the 1970 requirements.

Significant Deterioration. Intensive efforts have been made to clarify the intent of Congress to prevent significant deterioration of ambient air quality in regions that are cleaner than national standards require. Following a court decision, the U.S. Environmental Protection Agency (EPA) proposed regulations to protect clean air areas from experiencing air quality degradation.[1] Both EPA and Congress recognized the need for a delicate tradeoff between preserving clean air in areas where it is most important, and not bringing development to a full stop. The conflict is a problem in western states where coal and other energy resources are likely to become very important.

EPA's strategy in dealing with this problem was to establish three classes of areas: Class I, where air quality could be degraded only slightly; Class II, where moderate, but not substantial, deterioration could occur; and Class III, where air quality could be degraded to national standards.[2] Congress tended to adopt the same basic strategy, but substantial debate has occurred on such issues as whether there should be mandatory Class I designation for certain areas, how stringent the limitations should be in each of the classes, and whether there should be any Class III designation at all.

Supplementary Controls. Congress had two controversial issues: whether polluters must reduce pollution emissions to very low levels all the time, even if ambient air quality exceeds standards only intermittently, or whether, in certain circumstances, polluters can abate to a lesser degree, using tall stacks to disperse the pollutants more widely, thus reducing their concentration, and if air quality conditions were particularly bad, adopting supplementary controls, such as production cutbacks and switching to clean fuels. Several courts of appeal have held that the 1970 amendments required continuous emissions reduction.[1] However, some industries, especially electric utilities and copper smelters, have argued that continuous source reduction is unnecessary and too expensive.

Nonattainment Areas. A potentially important, although not yet widely recognized, issue is whether new sources would be allowed in areas that fail to meet ambient air quality standards. Under the 1970 amendments, no new sources and no substantial expansion of old sources could occur in an area that exceeds ambient air quality standards if the proposed sources emit any pollutants for which the standard is exceeded. Of the 247 Air Quality Control Regions (AQCR) in the country, several have failed to meet the 1975 standards for one or more pollutants. Table I-2 is the national summary of the 1974 AQCR status by pollutant as reported by EPA. Although only small portions of many of these areas exceed the standards, this

TABLE I-1. Proposed automobile emissions standards by year in which emissions standards would be required

Proposal	Hydrocarbons			Carbon monoxide			Nitrogen oxides				
Emissions standard, grams per mile	1.5	0.9	0.41	15.0	9.0	3.4	3.1	2.0	1.5	1.0	0.4
1970 Clean Air Act	1976		1977	1976		1977	1976	1977			1978
Schedule as of January 1976	1976-77		1978	1976-77		1978	1976	1977			1978
EPA Proposal (March 5, 1975)	1977-79	1980-81	1982	1977-79	1980-81	1982		1977-81			
President's Proposal (July 28, 1975)	1976-81			1976-81			1976-81				
Senate Staff Proposal (August 8, 1975)	1976-77		1978	1976-77		1978	1976-77			1978-81[a]	1982
House Subcommittee	1976-77	1978-79	1980	1976-77	1978-79	1980		1977-79			1980[b]
Senate Committee Bill	1976-78		1979	1976-78		1979	1976	1977-79		1979[c]	
House Committee Bill	1976-79		1980	1976-79		1980	1976	1977-80			1981[d]

[a] Applies to only 50 percent of vehicles and engines in 1978 and 1979.

[b] Administrator may grant annual suspensions based on unavailability of technology or excessive fuel penalties, but interim standards are not to exceed 1.5 gpm in 1980-81 and 1.0 gpm in 1982-84.

[c] Applies to only 10 percent of vehicles in 1979 and 100 percent in 1980.

[d] Administrator would be able to grant yearly suspension of this requirement. Maximum allowable standards with such suspension would be 2.0 for 1981-82, 1.5 for 1983-84, 0.4 for 1985 and beyond.

TABLE I-2. AQCR attainment status by pollutant: 1974

Air Quality Control Regions [a]	Total suspended particulates	Sulfur dioxide	Carbon monoxide	Oxidants
Number reporting minimal data [b]	236	210	92	86
Number exceeding 24-hour primary standard [c]	99	22	—	—
Number exceeding annual primary standard [c]	111	11	—	—
Number exceeding 1-hour standard [c]	—	—	13	76
Number exceeding 8-hour standard [c]	—	—	53	—

[a] Total number of AQCRs = 247.

[b] At least three 24-hour values for intermittent monitors or 400 hourly values for continuous monitors.

[c] An AQCR must have *all* reported stations showing no violations to be considered an "attainment AQCR." If a single station in an AQCR reports a violation, the entire AQCR is considered a "nonattainment AQCR."

requirement could potentially stop industrial expansion in many developed parts of the nation.

Flexibility of Administration. Congress also addressed the issue of how much flexibility regulatory authorities would have to permit delays and variances from abatement requirements. Under the 1970 amendments, the regulatory authority could allow delayed compliance with variances as long as ambient air quality standards were not exceeded. There has been an effort to restrict the period for which variances could be issued and to impose an economic penalty (approximately equal to the expected cost of pollution abatement to the firm) on pollution sources not yet in compliance. This penalty would prevent a firm from gaining an economic advantage over its competitors by delaying its pollution control expenditures.

Transportation Control Plans (TCPs). TCPs to achieve reductions in automobile-related pollutants have been controversial from the beginning. The purpose of these plans is to discourage the use of automobiles in polluted areas and to reduce automobile emissions.

Typical TCPs incorporate such strategies as exclusive bus lanes, mass transit improvements, car pooling, downtown parking restrictions, and inspection and maintenance of emissions control systems. Some TCPs stimulated local opposition because they could impose substantial costs on the community and on its residents. There has been substantial pressure to postpone the implementation of TCPs and to restrict in general the conditions under which these plans could be adopted.

Catalyst-Equipped Cars

The experience of the past year and a half has indicated that catalysts are an effective answer for automobile emissions control, with added benefits of improving fuel economy and drivability. Field experience to date indicates that their performance is reliable. However, some catalysts may have drawbacks. Catalyst cars equipped with air pumps emit sulfates, and thus increase atmospheric levels of sulfates. The health effects implications are not yet fully understood. In the future, new engine and control technologies may replace the catalytic control system.

Stringent emissions standards for passenger automobiles and a timetable for imposing them were set by the Clean Air Act Amendments of 1970. This timetable has been modified several times. Congress set the schedule back 1 year when it passed the Energy Supply and Environmental Coordination Act (ESECA) of 1974.[3] EPA administrative action further postponed the effective date of the statutory standards, which at present are scheduled to take effect in 1978. Cars produced for sale in California must meet stricter standards than those set for the other 49 states. The current status of these standards is summarized in Table I-1.

Until model year 1975, the automobile industry made incremental changes in engines in order to meet the standards. The cumulative effect of these changes was to create moderate penalties in the form of poor gas mileage, poor starting in cold weather, and poor drivability. The technology developed to meet the statutory standards could not be compressed further to meet either the 1976 California standards or model year 1977 standards for the other states. After the energy crisis, the demand for improved fuel economy was another incentive for a new approach.

For all these reasons, the industry has begun to use catalytic control technology for most model 1975 cars. Seventy percent of the 1975 fleet and 85 percent of the 1976 fleet are catalyst-equipped. To meet the lower California limits, California cars differ from those produced for the rest of the nation because they use air pumps to further reduce emissions. These pumps provide additional air to the catalyst, thereby improving its efficiency in reducing emissions of hydrocarbons and carbon monoxide. The air pumps, however, can increase the emissions of sulfuric acid aerosol, a sulfate, which is more harmful than sulfur dioxide, although its exact impact on human health is still not completely understood. EPA has deferred regulatory action until more complete data become available regarding the potential health effects of these emissions.

Table I-3 lists the emissions profiles of several popular models of cars, as certified by EPA, for both the 49-state and California versions.[4] The emissions of these cars are well within the statutory limits. However, the cars tested were prototypes equipped with preproduction emissions control equipment and were not necessarily representative of production models in public use. Prototype models are tested well in advance of assembly line production to ensure meeting the emissions standards. Preliminary field data show that emissions from production cars are not as low as those found at certification.

TABLE I-3. Measured emissions from 1976 certified cars equipped with catalysts in comparison to the statutory standards[4]

Car	Forty-nine-state data[a]			California data[a]		
	Hydro-carbons	Carbon monoxide	Nitrogen oxides	Hydro-carbons	Carbon monoxide	Nitrogen oxides
Ford (302)[b]	0.7	3.0	3.0	0.6	3.5	1.0
Chevrolet (350)	0.5	8.0	2.3	0.5	3.7	1.7
Plymouth (318)	0.8	7.0	2.2	0.9	3.4	1.1
Datsun B210	1.2	9.0	2.1	0.5	4.1	1.6
Mercedes (168)	0.4	3.0	1.6	0.4	3.3	1.6
Hornet (304)	0.4	3.0	2.7	0.6	5.8	1.9
Standards	1.5	15.0	3.1	0.9	9.0	2.0

[a] Emissions data are in grams per mile and include a deterioration factor.
[b] Numbers in parethenses denote engine displacement class in model tested.

Indications are that average emissions from some catalyst-equipped cars in actual use may be above the hydrocarbon and carbon monoxide standards. Nevertheless, records of these cars are better than those of older cars equipped with precatalyst devices.

As part of a six-city survey conducted by EPA, about 300 consumer-used 1975 cars were tested in Chicago and Houston. The data in general indicate that many of the cars tested do not comply with the law for carbon monoxide emissions and some do not meet the hydrocarbons standard. Among millions of cars, it would be extremely difficult to ensure that *all* meet the standard, but it is reasonable to expect that random testing of cars produced for sale would show about half above the standards and half below (assuming that the certified vehicle exactly meets the standards). However, 87 percent of the vehicles produced by one manufacturer failed to meet the carbon monoxide standard; this extreme failure rate is caused by a mechanical rather than a statistical phenomenon.

The present high failure rate seems to be due to adjustments made by owners or mechanics which are contrary to instructions by manufacturers. The industry is taking steps to prevent "tinkering," which may solve the problem. Programs for inspection and good maintenance of emissions controls could help to bring emissions from all cars in use close to the standards.

Catalyst controls seem to have an advantage in reliability. Catalyst-equipped cars in use have lower levels of emissions than older cars and emissions close to the relevant standards; there also is less variation from best to worst cars. Figure I-1 shows the trends in emissions for model years 1971-1975.[5] Emissions for each model were measured within 1 year of introduction. Thus, the data do not reflect possible deterioration in emissions control efficiency over the life of the car. Such deterioration has been significant for precatalyst cars.

Catalyst-equipped cars should operate either at or near their expected level or they completely fail to work. Gross failure can come

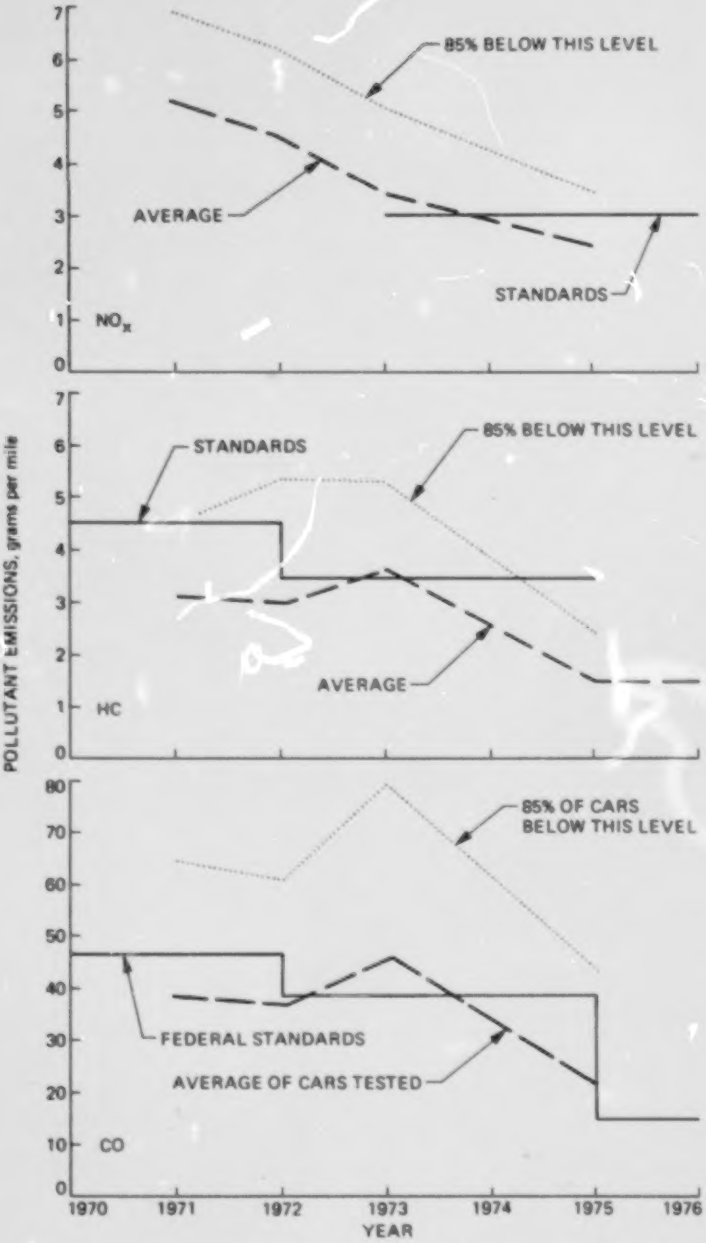


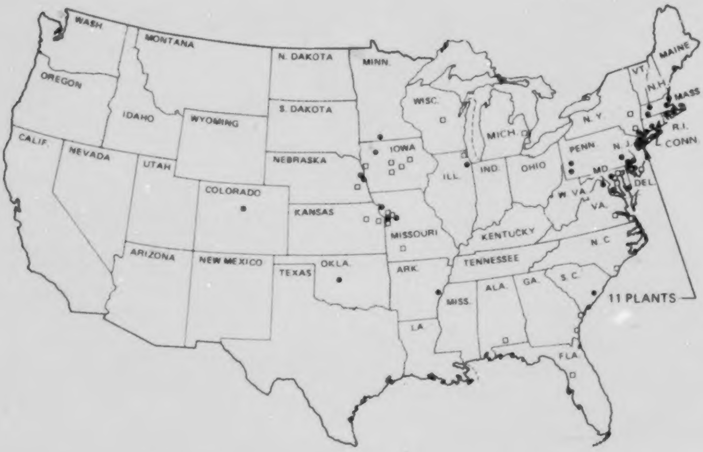
FIGURE I-1. Trends in emissions from in-use vehicles 1 year after production: 1971-1975 models (Sources: U.S. Environmental Protection Agency and Calspan Corp.)

from overheating the catalyst—a problem that has been insignificant to date—and using leaded gas. Although strict regulations are in force to prevent the use of leaded fuel in catalyst cars, few data exist regarding catalyst failures caused by lead contamination.

Gasoline mileage is continuing to improve. The projected sales-weighted fuel economy of the 1976 fleet is about 13 percent better than for 1975 and 27 percent better than for 1974.[6] The catalytic converter has been responsible for much of the improvement, but introduction of lighter-weight models, plus improved carburetion, transmissions, axle ratios, and ignition systems also have increased mileage.

ESECA and Powerplant Emissions

One goal of ESECA is to maximize energy independence.[3] One of the act's major provisions involves the conversion of oil-fired powerplants to the use of coal. Under the law, the U.S. Federal Energy Administration (FEA) selects powerplants as candidates for conversion, but final orders are subject to an EPA finding that the powerplant can burn coal without violating the air quality standards that protect human health. FEA designated 80 powerplants in 28 states as candidates for coal conversion; so far EPA has approved 32, and notices to convert have been issued. Figure I-2 shows the locations of those plants.[7]


WASH
MONTANA
N. DAKOTA
MINN.
OREGON
IDAHO
WYOMING
S. DAKOTA
WISC.
MICH.
N. Y.
VT.
N.H.
MAINE
MASS
R.I.
CONN
CALIF.
NEVADA
UTAH
NEBRASKA
IOWA
ILL.
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OHIO
PENN.
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COLORADO
KANSAS
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ARIZONA
NEW MEXICO
TEXAS
OKLA.
ARK.
TENNESSEE
S. C.
GA.
ALA.
MISS.
LA.
FLA.
11 PLANTS

● REMAINING CANDIDATES FOR CONVERSION (48)

☐ PLANTS ISSUED FEA NOTICE TO CONVERT TO COAL (32)

FIGURE I-2. Locations of candidate powerplants for coal conversion (Source: U.S. Environmental Protection Agency)

FEA is now reviewing the other 48 plants with a view to issuing conversion orders. Many of the plants in this group will have to use scrubbers (flue gas desulfurization) to prevent excess emissions of sulfur dioxide, and particulate control is required on all coal-burning plants.

EPA has reviewed all state air quality implementation plans to select potential areas where current controls may be unnecessarily restrictive. Relaxing these requirements will reduce the demand for clean fuels. About 30 out of 247 regions are candidates for relaxation of particulate control requirements.

Automotive Lead Emissions

A recent study of body lead levels is especially relevant to setting a rational emissions or ambient standard for lead. This study, conducted in California by EPA, has helped to clarify the longstanding controversy over the health effects of airborne lead from automobiles. Results of the study show substantially higher lead levels in children living near a major freeway in Los Angeles than in the rural desert town of Lancaster. Similar studies conducted elsewhere probably would yield similar findings.

The average atmospheric lead concentrations during the study period were 6.3 micrograms per cubic meter ($\mu g/m^3$) in Los Angeles and 0.6 $\mu g/m^3$ in Lancaster. The lead levels in soil were 30 times higher in Los Angeles than in Lancaster. Levels in drinking water were low and were not significantly different between the two study sites. Lead levels in paint were also low at both sites.

Table I-4 shows lead levels for male and female subjects in the age group of 1 to 16 years.[8] Levels in blood, urine, and short and long hair were markedly higher in the Los Angeles study group, indicating the higher airborne lead levels there. However, fecal lead levels are similar in Los Angeles and Lancaster, indicating little difference between the two groups in lead taken orally into the body. These data verify that the elevated body burden in the Los Angeles study group came from breathing lead, not eating or drinking it.

Ten percent of the blood lead samples in the age group tested in Los Angeles was above 40 micrograms per 100 milliliters ($\mu g/100$ ml) of blood, with a maximum of nearly 60 $\mu g/100$ ml. The maximum observed level in the Lancaster group was approximately 20 $\mu g/100$ ml. The medical community has expressed concern regarding the health implications of blood lead levels above 40 μg in children. Observed clinical symptoms of low-grade lead poisoning are associated with levels of 60 to 80 $\mu g/100$ ml.

The Natural Resources Defense Council (NRDC) won a suit in March 1976 to compel EPA to establish ambient air quality standards for lead.[9] Such standards will have to be set within 15 months as mandated by the provisions of the Clean Air Act. The

TABLE I-4. Body burden lead levels in the Los Angeles and Lancaster study groups: Ages 1 to 16[3]

Measurement	Sex	Study area[a]	
		Los Angeles	Lancaster
Blood lead, milligrams of lead per 100 ml	M	24	11
	F	17	10
Lead in long scalp hair, milligrams of lead per gram	M	59	21
	F	77	17
Lead in short scalp hair, milligrams of lead per gram	M	107	17
	F	70	12
Urine lead, milligrams of lead per liter	M	18	10
	F	16	14
Fecal lead, milligrams of lead per gram	M	1.7	1.4
	F	1.1	1.6

[a] Data rounded for clarity.

data derived from the Los Angeles/Lancaster study will help to provide the basis for selecting appropriate ambient values.

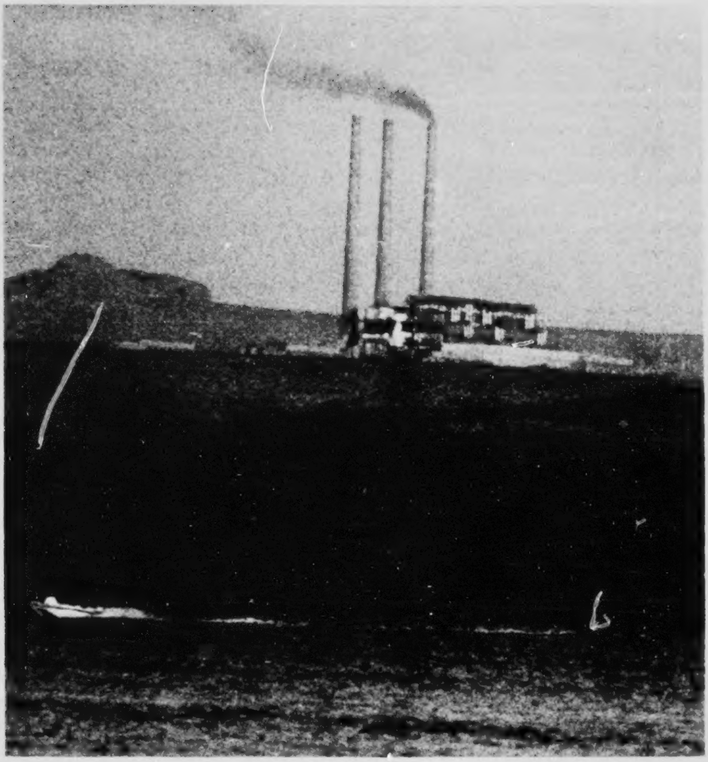
Control of Noncriteria Pollutants

In addition to the five "criteria" pollutants subject to current regulatory programs, several other pollutants are under special controls or are candidates for control.

Asbestos, beryllium, and mercury have been designated as hazardous pollutants, and vinyl chloride has been proposed as another. EPA has developed specific control strategies applicable to the processes that generate these pollutants; the strategies are periodically upgraded in light of new information. The manufacture of asphalt, concrete, shotgun shells, and the disposal of asbestos wastes have been added to the nine asbestos sources originally covered. The control of sewage sludge incinerators has been added to the source list of mercury emissions.

Several new regulatory actions by EPA are intended to decrease emissions in many industrial sectors. EPA proposed new source performance standards for six additional processes, bringing the total number of industries covered to 17. Such standards ensure that all newly constructed industrial plants use the best available emissions control technology. They focus on the control of sulfur oxides, fluorides, and particulates, including metals.

As for mobile sources other than passenger cars, more stringent emissions standards will soon be published regarding light- and heavy-duty trucks, buses, and other vehicles. Smoke emissions control requirements for diesel-powered vehicles will be tightened. Motorcycles also have come under scrutiny, and regulations were proposed in 1975. Because of inadequacies in measurement method, EPA has revised its test procedure for measuring the evaporative losses that now account for a large share of the total hydrocarbon emissions from new automobiles.



The Navaho powerplant in southern Utah releases pollutants into the otherwise clean desert air. Whether significant deterioration of clean air regions should be allowed has been a major issue this year in attempts to amend the Clean Air Act of 1970 (Photo credit: Glen Canyon National Recreation Area)

WATER

The United States is undertaking its fourth year of effort toward meeting the goals of the 1972 amendments to the Federal Water Pollution Control Act. This period has been one of high expectation and significant frustration. Water quality has not improved as rapidly as we had hoped, and there are still substantial delays in fully implementing many sections of the act.

Industrial Point Sources

Progress in implementing the law as it pertains to industrial polluters may be measured by the number of effluent limitation guidelines and point source permits issued.

EPA issues effluent limitation guidelines for each industry, defining the pollution loads allowable under the 1977 standard of "best practicable technology" and the 1983 standard of "best available technology, economically achievable." Table I-5 summarizes EPA's progress in issuing these guidelines.

Guidelines issued to the pulp and paper and iron and steel industries between June 1975 and April 1976 are exceptionally important, both economically and environmentally. The pulp and paper industry uses more process water than any other U.S. industry and is one of the industries most significantly affected by the legislation (see the Economics section of this chapter for further discussion of these impacts). The iron and steel industry has posed some of the nation's most serious water pollution problems, especially where several plants are grouped together, as in the Mahoning River Basin in Ohio. In an unusual action in March 1976, EPA issued special effluent guidelines for eight steel plants in the Mahoning Valley. These plants have been allowed substantially lower abatement requirements than those ap-

TABLE I-5. Status of effluent guidelines: May 1976 (Source: U.S. Environmental Protection Agency)

Industry groups	Number of subcategories	Date proposed[a]	Date promulgated[a]
Group I, Phase I			
Fiberglass	1	8/22/73[b]	1/22/74
Beet sugar	1	8/22/73	1/31/74
Feedlots	2	7/ 7/73	2/14/74
Glass	6	9/ 7/73	2/14/74
Cement	3	9/ 7/73	2/20/74
Phosphate	3	10/ 7/73	2/20/74
Rubber	4	10/11/73	2/21/74
Ferroalloy	3	10/18/73	2/22/74
Asbestos	7	10/ 5/73	2/26/74
Meat	4	10/30/73	2/28/74
Poultry	5	4/24/74	
Inorganics	22	10/11/73	3/12/74
Cane sugar	2	10/29/73	3/20/74
Grain mills	6	10/11/73	3/20/74
Fruits and vegetables	5	11/30/73	3/21/74
Electroplating	1	12/ 7/73	3/28/74
Plastics and synthetics	13	11/ 9/73	4/ 4/74
Nonferrous	3	12/ 4/73	4/ 8/74
Fertilizers	5	12/26/73	4/ 8/74
Leather tanning	6	4/ 8/73	4/ 9/74
Soap and detergent	19	12/14/73	4/12/74
Timber products	8	12/20/73	4/18/74
Organic chemicals	3	12/ 7/73	4/25/74
Petroleum refining	5	1/15/74	5/ 9/74
Builders paper	1	12/17/73	5/ 9/74
Dairy	11	1/14/74	5/28/74
Pulp and paper	5	2/6/74	5/29/74
Seafood	14	1/3/74	6/26/74
Iron and steel	12	2/19/74	6/28/74
Textiles	7	2/5/74	7/5/74
Steam electric	4	3/4/74	10/8/74

[a] Published in *Federal Register*.
[b] Interim final guidelines.

TABLE I-5—Continued

Industry groups	Number of sub-categories	Date proposed[a]	Date promulgated[a]
Group I, Phase II			
Glass	6	8/21/74	1/16/75
Rubber	7	8/23/74	1/10/75
Meat	6	8/28/74	1/3/75
Timber	7	8/26/74	1/16/75
Asbestos	4	8/29/74	1/9/75
Grain mills	4	8/17/74	1/3/75
Plastics and synthetics	11	9/20/74	1/23/75
Fertilizer	2	10/7/74	1/14/75
Phosphates	3	1/27/75 [b]	
Ferroalloys	5	2/24/75 [b]	
Inorganics	41	5/22/75 [b]	
Seafoods	19	1/30/75 [b]	12/1/75
Cane sugar	5	2/27/75 [b]	
Nonferrous	5	2/27/75 [b]	
Electroplating	3	4/24/75 [b]	
Organics	4	1/5/76 [b]	
Fruits and vegetables	51	10/21/75 [b]	4/16/76
Pulp and paper	10	2/19/76 [b]	
Iron and steel	23	3/29/76 [b]	
Foundries			
Carbon and alloy			
Group II			
Furniture	4	11/14/74	6/2/75
Asphalt paving	4	1/10/75	7/24/75
Paint and ink	4	2/26/75 [b]	7/28/75
Auto and other laundries			
Fish hatcheries	3		
Transportation	7		
Converted paper			
Petroleum and gas extraction	4	9/15/75	
Steam supply	2		
Coal mining	4	10/17/75	
Water supply	15		
Mineral mining	17	10/16/75	
Explosives	4	3/9/76	
Miscellaneous chemicals			
Carbon black	4	5/18/76	
Adhesives and sealants			
Gum and wood chemicals	6	5/18/76	
Hospitals		5/6/76	
Photographic processing			
Pharmaceuticals			
Pesticides			
Machinery and mechanical products			
Ore mining and dressing	7	11/1/75	
Food and beverages			
Clay and gypsum			
Concrete products			

[a] Published in *Federal Register.*
[b] Interim final guidelines.

plied to steel mills in the rest of the nation. According to EPA, enforcement of national regulations for these older facilities of U.S. Steel, Republic Steel, and Youngstown Sheet and Tube would cause "severe economic and employment disruptions" (see the Economics section of this chapter for further discussion).

In another unusual action in April 1976, EPA withdrew effluent guidelines for organic chemicals, excluding butadiene, as a direct result of legal challenge by the industry.[10]

EPA continues to work on the remaining industrial categories, but much of the agency's effort has been focused on these very important and difficult industries.

EPA must also issue other major guidelines pertaining to "new sources," discharges proposed by industry after enactment of Public Law 92-500, and to pretreatment of industrial wastes that are to be discharged into municipal waste treatment systems. The "new source performance standards" are frequently equivalent to the 1983 limitations for existing industries. The development of pretreatment standards for existing industries continues. Pretreatment guidelines issued through May 1976 are given in Table I-6.

The guidelines are translated into individual abatement requirements through the National Pollution Discharge Elimination System

TABLE I-6. Status of pretreatment regulations (Source: U.S. Environmental Protection Agency)

Industry	Number of subcategories	Pretreatment regulations			
		Number for existing sources		Number for new sources	
		Proposed	Promulgated	Proposed	Promulgated
Dairy	12	12	12	12	12
Grain mills	10	10	6	10	10
Fruits and vegetables	8	8	8	8	8
Seafood	33	33	33	33	14
Sugar	8	8	3	8	1
Textile	7	7	0	7	7
Cement	3	3	3	3	3
Feedlots	2	2	2	2	2
Electroplating	5	5	0	5	0
Organic chemicals	7	7	3	7	3
Inorganic chemicals	49	49	0	49	22
Plastics and synthetics	20	20	0	20	20
Soap and detergent	19	19	15	19	19
Fertilizer manufacturing	7	7	0	7	7
Petroleum refining	5	5	0	5	5
Iron and steel manufacturing	12	12	0	12	12
Nonferrous metal	8	8	0	8	3
Phosphate manufacturing	6	6	0	6	3
Steam electric power	4	4	0	3	3
Ferroalloy	7	7	0	4	3
Leather	6	6	0	6	6
Glass	14	14	4	14	13
Asbestos	11	11	7	11	11
Rubber	11	11	0	11	11
Timber	13	13	0	13	13
Pulp and paper	5	5	5	5	5
Builder paper and board	1	1	1	1	1
Meat products	15	15	4	15	10
Paint formulating	1	1	0	1	1
Ink formulating	1	1	0	1	1

(NPDES) by requiring permits for every point source discharger. As indicated in Table I-7, the number of permits issued for industrial sources continues to increase, with 90 percent of major dischargers and 67 percent of all industrial dischargers receiving permits as of March 31, 1976. The rate at which additional permits are issued will probably decrease as more time and effort are required to reach agreement with the remaining major industrial sources.

There have been unexpected delays in implementing the complicated administrative requirements of the 1972 amendments. Effluent guidelines have not been issued for all industries, but many firms have received permits and will meet the 1977 deadlines; others will not practicably be able to do so.

Beyond these administrative delays, there is some evidence that the system is not achieving the tight pollution controls required by the legislation. Three steps are necessary to satisfy the law's requirements. First, EPA prepares effluent guidelines to meet the mandated abatement standards (i.e., best practicable technology and best available technology). Second, each polluter receives a permit requiring him to satisfy the effluent guidelines. Third, the discharger reduces his effluents in accordance with the schedule and requirements stated in the permit. Delays occur when guidelines are not prepared according to schedule, when special technological problems exist in writing the permit, or when technology or resources impede effluent reduction by the discharger.

Several consultants to the National Commission on Water Quality (NCWQ) concluded that effluent guidelines prepared by EPA cannot meet the requirements of the legislation because they are based on inadequate technology. The consultants feel that more stringent (and therefore more expensive) abatement requirements are necessary. EPA does not agree with these conclusions, and there have been no court decisions requiring EPA to strengthen its guidelines.

During the past year, several observers also questioned whether the permits are actually satisfying the conditions established by the

TABLE I-7. Status of permits issued under the NPDES: January 1976 (Source: U.S. Environmental Protection Agency)

Types of dischargers	Total identified dischargers	Permits issued as of June 1975	Permits issued as of January 1976
Industrial (and other non-municipal)	41,454	21,639	26,958
Major	4,655	2,797	4,213
Minor	36,799	18,842	22,745
Municipal	20,664	16,664	16,845
Major	4,604	2,714	4,375
Minor	16,060	13,950	12,470
Federal facilities		1,988	2,062
Major			226
Minor			1,836
Total		40,291	45,865

guidelines. An analysis of the program by the General Accounting Office (GAO) indicates that "the effluent discharge limitations in 50 industrial permits GAO reviewed were, for the most part, not based on final guidelines." [11] To a large extent this was because "the final guidelines were not published in time to be used in permit writing or were not applicable." [11]

GAO also found that some dischargers were not adhering to the conditions of their permits. They concluded that the permit program faces major problems, but that it is too early to determine its long-term effectiveness.[12]

Much of the delay and uncertainty associated with pollution abatement results from the number of legal and administrative challenges to the requirements of the guidelines and the conditions of the permits. Requests for administrative hearings have been pending for more than one-tenth of the major industrial permits issued by EPA, as of March 31, 1976.[13]

There is general agreement that the permitting program can be accelerated by having more states assume the permitting authority. As indicated in Table I-8, four states were given this authority from July 1, 1975, through July 6, 1976. However, the prospects are dim for the states to assume these responsibilities in the near future. An EPA report released in December 1975 concludes that progress toward decentralization by formal program delegations "has reached a point of diminishing returns," because few states have the staff capability to assume large-scale delegation.[14] The report also notes that insufficient funding for state agencies is the single most important obstacle to a more effective division of labor between EPA and the states.[15]

Toxic Effluents

EPA plans to issue regulations to control the discharge of 65 toxic chemicals into the surface waters of the nation. The EPA plan

TABLE I-8. States assuming NPDES responsibilities (Source: U.S. Environmental Protection Agency)

State	Date assumed	State	Date assumed
California	May 14, 1973	Minnesota	June 30, 1974
Oregon	Sept. 26, 1973	Maryland	Sept. 5, 1974
Connecticut	Sept. 26, 1973	Missouri	Oct. 30, 1974
Michigan	Oct. 17, 1973	Hawaii	Nov. 28, 1974
Washington	Nov. 14, 1973	Indiana	Jan. 1, 1975
Wisconsin	Feb. 4, 1973	Colorado	March 27, 1975
Ohio	March 11, 1974	Wyoming	Jan. 30, 1975
Vermont	March 11, 1974	Virginia	March 31, 1975
Delaware	April 1, 1974	South Carolina	June 10, 1975
Mississippi	May 1, 1974	North Dakota	June 13, 1975
Montana	June 10, 1974	Nevada	Sept. 19, 1975
Nebraska	June 12, 1974	North Carolina	Oct. 19, 1975
Georgia	June 28, 1974	New York	Oct. 28, 1975
Kansas	June 28, 1974		

emerged from the settlement of a lawsuit brought by the Natural Resources Defense Council, the Environmental Defense Fund, and other groups who charged that EPA failed to control any toxic effluents under Section 307.

The pollutants covered by the agreement generally will be regulated by effluent guidelines to achieve best available technology for relevant industries. Under the agreement, the more formal procedure of nationwide, industrywide effluent standards under Section 307 will be applied only to a limited number of chemicals, including endrin, toxaphene, eldrin, dieldrin, DDT, benzicline, and PCBs. A 3-year study of the effects of the pollutants, technical feasibility, and economics of the control technology will be part of the development of the standards. The project is expected to be completed by 1979.

Municipal Point Sources

Progress by municipalities in abating pollution from their wastewater systems has been dependent upon the federal government's progress in obligating funds under the municipal grants program (Sections 201 to 207 of the Federal Water Pollution Control Act). Each year federal obligations have increased (see Table I-9) and all of the $18 billion made available under Public Law 92-500 is now expected to be obligated by September 1977.

The grants program has experienced a number of problems over the past few years, and a new one has recently arisen.[16] The problem is that some of the money is not being used even after it is obligated.

TABLE I-9. Financial summary of municipal treatment grants (Source: U.S. Environmental Protection Agency)

Fiscal year	Annual authorization	Annual appropriation	Annual obligations	Annual expenditures
1957	50	50	38	1
1958	50	45+	47	17
1959	50	47+	46	36
1960	50	46+	48	40
1961	50	46+	45	44
1962	80	80	64	42
1963	90	90	92	52
1964	100	90	85	66
1965	100	90	84	70
1966	150	121	118	81
1967	150	150	131	84
1968	450	203	191	122
1969	700	214	201	135
1970	1,000	800	424	176
1971	1,250	1,000	1,152	478
1972	2,000	2,000	860	413
1973	7,000[a]	3,900[b]	2,989	684
1974	6,000	3,000	2,625	1,553
1975	7,000	4,000	3,759	1,956

[a] Includes $2 billion for reimbursement to municipalities for prior construction.
[b] Includes $1.9 billion for reimbursement to municipalities for prior construction.

At the end of 1975, $2.3 billion of the grant funds approved by EPA had not been accepted by the grant recipients.[17] The reasons for the delay are not clear, but may result in part from the inability or unwillingness of municipalities to commit matching funds because of general financial problems. EPA was planning to obligate $2.7 billion between January and July 1976.[18]

The flow of acceptable applications for the amounts of grants planned depends on the rapidity with which work can be completed on projects in the planning phase. Under the planning grants program, municipalities can apply for construction grants only when the planning phase is completed. Table I-10 summarizes information on the number of projects presently in planning, under design, and under construction; the rate at which projects have entered these three phases during the past 3 years; and projections for the number of projects in each phase through 1977. It takes 1 to 3 years for projects in the planning phase to be ready for construction.

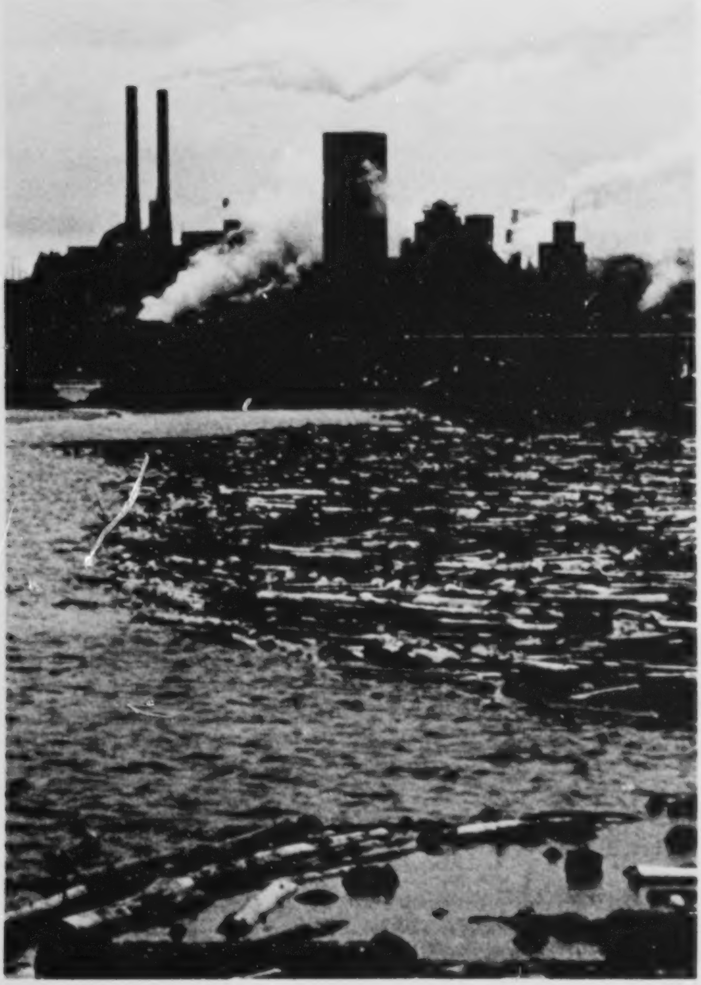
The rate for disbursing grants remains one of the most controversial issues involving the grants program; however, several other issues discussed in last year's Annual Report also remain important. A GAO analysis of the grants program concluded that, in many cases, the projects were not operating effectively, that adequate environmental assessments were not being conducted, and that there was insufficient public participation in the planning process.[19] This analysis covered projects initiated before enactment of Public Law 92-500, and EPA has subsequently corrected many of these problems.

GAO conducted a detailed study of five plants and found that none met design performance standards "because of poor operation and maintenance, plant overloading, or possible faulty design."[20] None of the plants experienced substantial cost overruns. Although GAO did not assess the cost effectiveness of the designs, it was con-

TABLE I-10. Grants for municipal sewage projects under Public Law 92-500 (Source: U.S. Environmental Protection Agency)

Grants	Step I		Step II		Step III	
	Number	Millions of dollars	Number	Millions of dollars	Number	Millions of dollars
FY 1973	1	0.002	46	58.6	474	1,532.7
FY 1974	479	47.2	94	16.2	455	1,335.2
FY 1975	1,637	92.1	268	79.0	641	3,238.2
FY 1976 (as of April 1976)	1,870	95.2	509	93.4	620	1,787.7
	Step I		Step II		Step III	
Number of projects to date	3,328		627		1,665	
Number of projects to date	286		169		246	

cluded that grant applications did not include adequate cost comparisons for alternative designs, as the 1972 law requires.[21] In an attempt to stimulate more cost-effective designs, EPA issued new and more detailed planning guidelines in May 1975.[22] GAO also concluded, as CEQ had previously stated, that there was inadequate assessment of possible adverse environmental impacts resulting from the projects.[23]



This paper and pulp plant, along with others in the industry, will be significantly affected by EPA's effluent guidelines for point sources soon to be promulgated. This industry uses more process water than any other U.S. industry (Photo credit: U.S. Environmental Protection Agency—Documerica, Lee Lockwood)

The GAO review further questioned the adequacy of project reserve capacity as required by law. At the same time, however, the Administration submitted to Congress a bill to eliminate federal funding for reserve capacity built to serve future population growth.[24] The purpose of the Administration's amendments was twofold: to reduce the federal cost of new facilities to stretch available funds to more projects dealing with existing pollution problems, and to reduce possible secondary effects and adverse environmental impacts from projects with excess capacity.[25]

The Administration also has submitted amendments aimed primarily at reducing federal costs for municipal waste treatment.[25] The amendments, among other things, would eliminate certain types of facilities (those dealing with collection sewers and storm sewers) from the federal grants program and would reduce the federal share of others (combined sewers, for example). Another amendment would allow case-by-case extension of the July 1, 1977, deadline for municipalities. The future of these proposed amendments is uncertain, although there is support for extending the 1977 deadline.

States' Role in Water Pollution Control

As shown in Figure I-3, although the federal government is the largest contributor to the total water pollution control effort, the states have supported most of the administration and monitoring costs. The states' share of these costs has varied from a high of 76 percent in 1971 to about 58 percent this fiscal year. The federal share has steadily increased during this period.

Figure I-4 shows that the states committed from 44 to 90 percent of the total manpower in eight program categories (administration and monitoring being most important) from 1974 through 1976. Federal contributions of manpower have been predictably greater in programs of enforcement, permits, and municipal facilities. Table I-11 shows progress made by the states in achieving their goals in FY 1975. The importance of the states in pollution abatement is indicated by the fact that they issued 15 percent of the total number of permits for major industries issued during the year.

With the strong emphasis on delegating administration and enforcement to the state and local levels, the preeminence of the states should remain, and may increase. This emphasis has been reaffirmed in the hearings on proposed amendments to the Federal Water Pollution Control Act (H.R. 9560) and by the joint report on decentralization prepared by EPA and state representatives.[26] The decentralization report indicates progress in the effort to keep responsibilities for cleanup on a local level and supports the recommendations on this subject made by the National Commission on Water Quality[27] and the Water Pollution Control Federation.[28]

As indicated in Table I-12, the states are also providing substantial financial support to localities for the construction of municipal wastewater treatment systems.

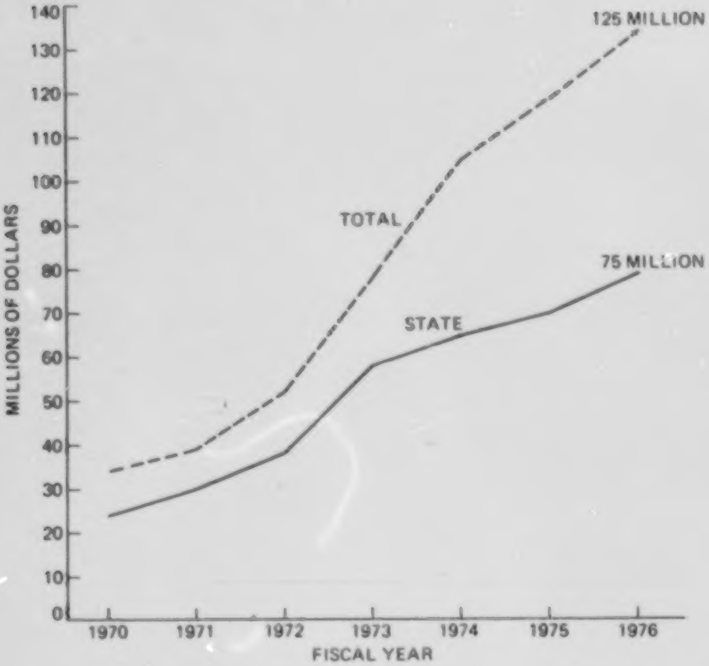


FIGURE I-3. Funding for state water pollution control program operations (Source: U.S. Environmental Protection Agency)

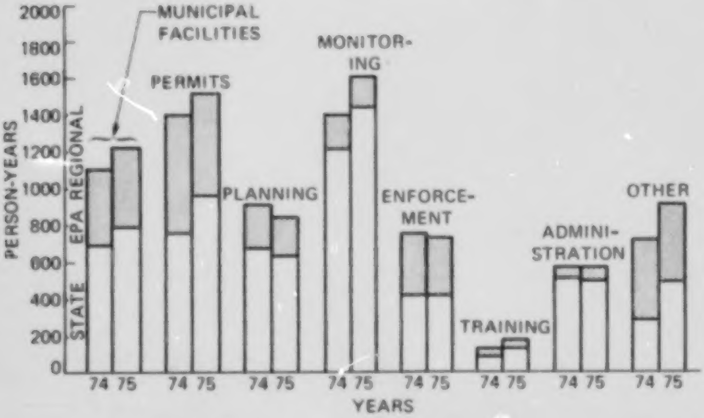


FIGURE 1-4. Effort toward state water pollution control operations (Source: U.S. Environmental Protection Agency)

TABLE I-11. Fiscal year 1975 outputs (in billions of dollars) (Source: U.S. Environmental Protection Agency) *

Program area	Planned FY 75	Actual FY 75	Percentage achieved
NPDES delegation (states)	35	24	69
Operation and maintenance manual delegation (states)	40	35	88
Planning and standards review delegation (states)	38	29	76
Water quality limited segment analyses	2,170	1,712	79
Basin plans completed	390	115	29
Major industrial permits issued by states	820	778	95
Minor industrial permits issued by states	11,892	10,804	91
Major municipal permits issued by states	875	782	89
Minor municipal permits issued by states	6,169	5,097	93
Construction grant awards	6.5	3.6	55

* Data obtained through EPA's Federal Planning and Reporting System and Grants Activity Report.

TABLE I-12. FY 1975 federal-state total dollars compared to federal contribution (Source: U.S. Environmental Protection Agency)

State/region	National total	Federal contribution	Federal share
Region I			
Connecticut	1,912,348	710,298	37
Maine	1,383,827	146,900	11
Massachusetts	1,961,126	951,600	49
New Hampshire	1,848,800	271,800	15
Rhode Island	570,300	342,300	60
Vermont	854,656	198,900	23
Region II			
New Jersey	3,508,925	1,137,035	32
New York	9,072,416	2,203,382	24
Puerto Rico	1,080,548	651,056	60
Virgin Islands	446,461	293,155	66
Region III			
Delaware	1,324,256	705,213	53
District of Columbia	432,622	270,029	62
Maryland	3,060,057	674,616	22
Pennsylvania	6,204,233	1,790,134	29
Virginia	5,125,140	1,006,112	20
West Virginia	870,760	430,940	49
Region IV			
Alabama	1,077,128	931,408	86
Florida	4,651,323	1,030,718	22
Georgia	2,053,428	1,246,499	61
Kentucky	1,517,259	588,288	39
Mississippi	1,167,378	595,097	51
North Carolina	2,831,253	1,468,797	52
South Carolina	1,943,653	795,947	41
Tennessee	1,867,072	795,367	43
Region V			
Illinois	7,415,518	1,499,380	20
Indiana	2,439,903	1,303,143	53
Michigan	5,049,700	1,933,987	38
Minnesota	2,072,614	749,367	36
Ohio	5,199,489	1,531,484	29
Wisconsin	3,371,516	1,085,316	32

TABLE I-12.—Continued

State/region	National total dollars	Federal dollar contribution	Federal share
Region VI			
Arizona	987,289	593,675	60
Louisiana	1,155,812	686,710	59
New Mexico	525,604	262,931	50
Oklahoma	694,626	442,600	64
Texas	6,372,210	1,477,400	23
Region VII			
Iowa	834,851	661,682	79
Kansas	1,033,211	421,822	41
Missouri	1,169,406	755,190	65
Nebraska	898,367	502,900	56
Region VIII			
Colorado	1,153,892	375,242	33
Montana	537,120	317,398	59
North Dakota	275,800	171,530	62
South Dakota	231,700	173,015	75
Wyoming	345,730	127,830	37
Utah	542,665	246,034	45
Region IX			
Arizona	631,976	325,900	52
California	11,025,400	2,355,848	21
Guam	339,899	248,868	73
Hawaii	649,001	283,263	44
Nevada	309,782	139,923	45
American Samoa	151,329	62,228	41
Trust Territories	183,040	134,887	74
Region X			
Alaska	260,878	131,039	50
Idaho	741,618	347,522	47
Oregon	1,609,218	667,700	41
Washington	1,787,286	872,500	49

Nonpoint Sources

Recognition of the seriousness of nonpoint source pollution has increased during the past year, but there has been little constructive progress in its regulation.

A decision by a U.S. district court in March 1975 forced EPA to reconsider and redefine discharges from storm sewers, relatively small feedlot operations, silvicultural activities, and irrigation return flows as point sources subject to permitting under NPDES.[29] Before this ruling, EPA excluded these activities from permitting requirements. In conformance with the 1975 decision, the agency has modified its definition of point sources, but still attempts to exclude the smallest activities.[30] Before this revised definition was issued, it was estimated that more than 2 million permits would be required, and the cost could exceed $1 billion.[11]

Studies sponsored by the NCWQ concluded that, in some areas, regulation of point source discharges alone will not improve water quality enough to meet the water quality goals. In many cases, the substantial costs involved in going from the 1977 to the 1983 standards may not noticeably improve water quality because of the small amount of pollution removed from regulated point sources compared with pollutant loadings from natural sources, unregulated agricultural activities, urban stormwater runoff, and other nonpoint sources.

Agriculture is a major source of suspended solids (sediment), dissolved salts, nutrients, herbicides, and pesticides.[31] Urban stormwater runoff contributes these same pollutants plus carbon and cadmium from automobile tires, lead and other particulates from exhausts and industrial smoke stacks, drainage from small industry and services, detergents from laundries, petroleum in various forms, other assorted organics, and heavy metals. According to a study conducted by Enviro Control for CEQ, from 40 to 80 percent of the total degradable material entering city surface waters comes from sources other than treatment plants; this strongly implicates urban stormwater.[32]

To deal with nonpoint source pollution, EPA plans to rely upon the regional comprehensive planning required by Section 208 of the Federal Water Pollution Control Act. However, no additional Section 208 planning agencies have been funded since July 1, 1975. It is not clear whether the agencies given this planning responsibility have either the necessary authority or access to adequate financial and technical resources to cope with the nonpoint source problem. The

Water flowing from this animal feedlot carries a heavy load of organic waste. The seriousness of this and other nonpoint sources of water pollution has recently been addressed by EPA (Photo credit: U.S. Department of Agriculture, Soil Conservation Service)

Administration's proposed amendment would eliminate federal support for separate storm sewers.

Coastal Waters

During the past year, there has been some progress in reducing pollution in our coastal waters. Table I-13 shows that reported ocean dumping decreased 23 percent from 1974 to 1975.[33] The reduction occurred in all regions and for all waste types except dredged materials, which constitute about 90 percent of the materials dumped in coastal waters. The total amount of ocean dumping is now almost down to the 1968 level, again excluding dredged materials. It is not clear, however, how much of the decline resulted from reduced economic activity, especially in construction, nor is it clear whether land disposal of solid wastes has increased, as it must when ocean disposal decreases. A recent draft environmental impact statement by EPA [34] indicates that dumping of sewage sludge in the New York Bight is expected to increase substantially over the next few years as standards for secondary treatment are met. The higher the degree of treatment, the greater is the amount of sludge produced.[34]

Table I-14 shows that the total number of reported oil spills in U.S. waters decreased 25 percent from 1974 to 1975, but the total amount spilled increased 33 percent.[35] Because oil spills, unlike dumping, are accidental, year-by-year variations do not necessarily indicate a long-term trend.

The implications of large spills were again demonstrated in February 1976 when a barge carrying heavy heating oil sank and released approximately 820,000 gallons in Chesapeake Bay. It was the worst spill in the Bay's history. The full amount of damage was not immediately apparent because the oil first sank below the surface rather than floating on top of the water, as would normally be expected. Within 2 weeks, however, an estimated 20,000 birds died, and widespread damage was foreseen for the area's valuable fisheries from Smith Point (Va.)-Tangier Island (Md.) to the lower Chesapeake Bay.

An important and encouraging event during the year was the successful tracking of an oil spill to the responsible ship by an oil "fingerprinting" process developed by the U.S. Coast Guard. By determining the chemical composition of oil in a spill off Key Largo, Florida, the Coast Guard was able to trace the spill to a ship docking in Philadelphia. The ability to identify any offending ship should provide a significant deterrent against deliberate spills.

Debate continues on the advisability for treatment of wastewater to secondary standards, as required under current EPA guidelines, before effluents are discharged into the ocean. The NCWQ concluded that allowing only primary treatment for municipal sewage before it enters the ocean would in many cases have no measurable adverse impact on water quality,[36] and the cost savings could be significant.

TABLE I-13. Ocean dumping (in thousands of tons): 1968, 1973-1975 (Source: U.S. Environmental Protection Agency and Army Corps of Engineers)

Waste type	Atlantic				Gulf of Mexico				Pacific				Total			
	1968	1973	1974	1975	1968	1973	1974	1975	1968	1973	1974	1975	1968	1973	1974	1975
Industrial waste	3,013	3,642.8	3,642	3,322.3	696	1,408	950	123.7	981	0	0	0	5,050.8	5,050.8	4,592	3,446
Sewage sludge	4,477	4,898.9	5,010	5,039.6	0	0	0	0	0	0	0	0	4,898.9	4,898.9	5,010	5,039.6
Construction and demolition debris	574	973.7	770.4	395	0	0	0	0	0	0	0	0	973.7	973.7	770.4	395.9
Solid waste	0	0	0	0	0	0	0	0	26	0.2	0.2	0	26	0.2	0.2	0
Explosives	15	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0
Total	8,079	9,515.4	9,422.4	8,757.8	696	1,408	950	123.7	1,007	0.2	0.2	0	10,923.6	10,923.6	10,372.6	8,851.5

TABLE I-14. Spills in U.S. waters: 1971-1975 (Source: U.S. Coast Guard)

Spills, by category[a]	Number of incidents					Total volume, million gallons				
	1971	1972	1973	1974	1975	1971	1972	1973	1974	1975
Type of location										
Inland waters	631	682	1,722	2,815	1,995	1,409.8	2,270	7,117	8,924	6,884
Coastal waters	7,201	7,441	9,871	9,503	6,622	6,720	14,277	15,490	6,799.8	6,993
Open waters (Great Lakes or territorial seas)	315	423	571	251	1,020	37	24	419	108	3,364
Contiguous zone (from 3 to 12 miles from coastline)	396	801	483	164	133	651	34	1,218.8	24	4
High seas	193	583	681	1,233	728	20	2,197	68.9	52	6,879
Type of pollutant										
Light oil[b]	4,320	4,290	4,104	2,657	2,677	2,822	6,578	6,415	3,181	7,185
Heavy oil[c]	1,603	2,049	2,851	5,084	2,698	2,934	1,761	4,538	12,754.8	9,565
Solvent	([d])	([d])	49	44	45	([d])	([d])	32	13	10
Waste oil	930	890	1,003	1,094	958	164	8,067	1,211	111.9	3,483.8
Other oil	462	1,151	2,976	2,774	2,414	2,673	357	2,650	728	421
Other materials (including sewage, refuse, etc.)	269	428	774	470	552	115	2,025	8,339	1,193	3,437
Unknown	945	1,123	1,551	1,843	1,194	89	15	1,128	56.8	23.8
Source										
Vessels	2,134	2,493	3,550	3,726	2,804					
Dry cargo vessels	271	402	353	377	294	418	42	650	90.9	2
Tank ships	386	453	825	973	546	1,665	2,583.9	4,494	1,434	7,637
Tank barges	828	830	718	833	679	1,197.8	3,739	1,572	2,468	3,472
Combatant vessels	261	294	246	278	208	440.8	40.9	17.9	39	17
Other vessels	388	494	1,408	1,265	1,082	180	96	1,184	253	1,322
Land vehicles	77	145	305	373	312	101	172	741	7,885	1,105
Nontransportation-related facilities, refineries	188	185	214	155	2,509	2,206	42	166	772	4,268
Pipelines	([e])	216	559	557	534	([e])	1,237	1,847	6,205	2,416
Other transportation facilities	22	68	162	3,489	174	159.9	13	151	2,695	219
All other onshore and offshore facilities[f]	3,723	3,804	3,904	799	402	2,158	10,483	6,479	1,567	122.8
Miscellaneous and unknown	2,592	3,040	4,634	4,867	3,803	310	354[g]	7,009	603	3,524
Cause										
Casualty (includes collision, grounding, and blowouts)	124	360	2,793	952	147	2,045	4,082	16,068	4,861	5,874
Rupture, leak, or structural failure	2,757	2,201		2,352	1,018	2,715	4,823[h]		7,234.9	11,486
Equipment failure (valves, pumps)	947	1,542	1,872	2,103	1,502	274	293	800	1,100	1,843
Personnel failure	829	1,287	2,204	2,707	1,865	1,035.9	940	1,127.8	3,544	962
Deliberate discharges	359	457	599	316	473	50	68	2,176	292	192
Natural phenomena	94	257	354	380	345	5.8	8,045.9	2,051	242	172
Unknown	3,536	3,827	5,506	5,206	4,078	712	551	2,090	858	3,573.9
Total spills reported	13,966	9,931	13,328	13,966	10,538	8,839	18,085	24,314.9	16,916	24,126

[a] The U.S. Coast Guard has no reason to believe that the number of discharges in 1973 was any greater than in 1971 or 1972. The increase in the number reported probably reflected public awareness of the legal requirement to report discharges.

[b] Data for 1971, 1972 include gasoline, light fuel oil, kerosene, and light crude; 1973 data include crude oil, gasoline, and other distillate fuel oil.

[c] Data for 1971, 1972 include diesel oil, heating oil, heavy fuel oil, heavy crude, and asphalt; 1973 data include diesel oil, asphalt, and residual fuel oil.

[d] Data for 1973 added the category of solvents, previously included under several other categories.

[e] Pipeline data for 1971 are included under other categories.

[f] Changes in 1973 "sources" categories make it necessary to combine some onshore and offshore production, storage, and transfer facilities in order to compare data to those for 1971 and 1972.

[g] Changes in 1973 "cause" categories make it necessary to combine the categories of "casualty" and "rupture, leak, or structural failure."

[h] Includes one 6-million-gallon sewage spill.

Recommendations for Change

When Congress passed the 1972 amendments, it recognized that delay in meeting the goals could be expected and that, after some experience had been gained, it would be useful to have a full assessment of programs and prospects under the act to determine the need for a "midcourse correction." The NCWQ made this assessment, and in April 1976 presented its recommendations to Congress.[36] Many of the commission's findings and recommendations are summarized below.

Recognizing the problems involved in implementing the 1972 amendments, the NCWQ recommended changes in the law to achieve essential goals for water quality improvement without forcing needless or inefficient expenditures. As with any analysis of such a complicated subject, the commission's analyses and recommendations have raised substantial controversy. EPA and some members of the commission have expressed disagreement with various parts of the report, and all recommendations will be subjected to critical analysis.

One set of recommendations concerns deadlines. It is clearly impossible for all dischargers of pollutants to meet the act's 1977 deadline, but the commission did not recommend an across-the-board extension of this deadline. Rather it proposed incorporation of some flexibility into the act "for granting extensions, and even waivers, on a case-by-case and category-by-category basis." [36]

The commission took a different approach to the 1983 deadlines. It suggested postponing for 5 or 10 years the present requirements for uniform adoption of further pollution abatement beyond that required for 1977, pending further assessment of progress and prospects by a new commission by 1985. This new commission would reassess the desirability of the law's water quality goals, and would determine the best process for attaining the goals.

A second set of recommendations concerns the definition of water quality goals. The NCWQ recommended retaining the substance of the 1983 goal of "fishable and swimmable" waters, although it recognized that its attainment may be delayed. The commission also recommended that the ultimate goal of "zero discharge" (to be achieved in 1985, under present law) be changed to one "stressing conservation and reuse of resources." [36]

The third set of recommendations concerns specific pollutants and pollution sources that should be given increased emphasis. The NCWQ recommended achieving the "fishable and swimmable" goal by applying the "1977 requirements to all dischargers." This presumably includes some sources previously considered nonpoint sources by EPA. The commission specifically suggested flexible application of "control or treatment measures to irrigated agriculture" and support for "salinity alleviation projects to reduce salt loads from sources other than those resulting from man's activities." [36]

The commission recommended immediate attention to elimination of the discharge of toxic pollutants in toxic amounts, universal application of new source performance standards to all new point source discharges, and discharges into more heavily polluted waters, with periodic upgrading of permits. Emphasis has been placed on elimination of toxic pollutants from industrial sources because of its relevance to land disposal of sludge on agricultural lands.[36]

The last set of recommendations concerns administration and funding of the act. The commission recommended that 75-percent federal financing be continued at a rate of $5 to $10 billion a year for 5 to 10 years in order to stabilize municipal planning, and that all regulatory and administrative functions be turned over to the states.

Although this list of recommendations has been submitted to the present session of Congress, any action based on them will be postponed to the next session. They will certainly generate a great deal of debate. The environmentalists believe they are too lenient. Industries strongly support postponing the 1983 requirements and redefining and postponing the 1985 goal, but would prefer to see even more consideration given to the economic impact of pollution abatement requirements. In the meantime, the Administration has been preparing its own proposals for changes in the legislation.

HAZARDOUS SUBSTANCES

Each year this section of the Annual Report has reviewed the ill effects of substances that were most recently discovered to be hazardous. Some substances once thought innocuous are now well known: vinyl chloride, fluorocarbons, and polychlorinated biphenyls (PCBs), for example. The hazards of many others have yet to be discovered.

Fortunately, of the 3.5 million known chemical compounds, relatively few are highly toxic as they are currently used. As a result, however, we have been lulled into a false sense of security. Hundreds of new compounds are introduced into commerce each year, before their potentially harmful effects have been fully assessed and even as new problems are uncovered involving chemicals already in wide use. This year we report on several substances, such as Kepone, chloroform, and trichloroethylene, which have recently prompted concern.

A lack of testing, access to information, and communication has put the government and the scientific community in a reactive posture toward these problems. In some cases, no federal authorities exist to remedy problems once they are discovered.

The events of the past year have revealed an inability to deal with chemicals whose hazards are known. For chemicals such as PCBs, a problem has been the lack of coordinated and comprehensive legal tools to control major sources of environmental contamination. In some cases, delays have been caused by lengthy regulatory and court proceedings, and by shortages of available trained personnel and other resources. In some instances, however, such as occupational lead poisoning in Indianapolis and the Kepone tragedy in Hopewell, Virginia, the problem has been flagrant neglect of good occupational and environmental practices.

For the sixth consecutive year, Congress is considering legislation[37] designed to identify and control ecological and health problems of new chemicals before they are commercially produced—before they become widespread environmentally and important economically. This legislation would allow the federal government to set priorities and take affirmative actions to protect the environment and human health. As the events described here show, the need for this legislation is urgent.

Pesticides

Kepone. The massive contamination of Hopewell and its surroundings by the pesticide Kepone is an example of the hazards possible from insufficiently controlled chemicals. Kepone, a chlorinated hydrocarbon ($C_{10}Cl_{10}O$) used domestically as an ant and roach poison, is related to the chemicals DDT, aldrin, and dieldrin, all of which have been restricted by EPA.

In July 1975, Life Sciences, Inc., the sole manufacturer of Kepone and a spinoff of Allied Chemical Company, ended its 16-month-old production operation after Virginia state health officials found about 70 victims with Kepone poisoning. More than 20 of these persons have been hospitalized with untreatable ailments that include apparent brain and liver damage, sterility, slurred speech, loss of memory, and twitches of the eyes.[38] A National Cancer Institute (NCI) report states that Kepone also causes cancer in test animals.[39]

EPA found traces of Kepone in the air 16 miles from Hopewell, in river water 40 miles away, and in James River shellfish 64 miles from Hopewell. Governor Mills Godwin of Virginia closed more than 100 miles of the James River and its tributaries to commercial fishing until at least July 1, 1976. In July this ban was extended.

In March 1976, the U.S. Food and Drug Administration (FDA) adopted an action level of 0.3 parts per million (ppm), 0.1 ppm, and 0.4 ppm for Kepone-contaminated shellfish, finfish, and crabs, respectively. FDA uses such action levels to guide it in deciding whether or not to initiate enforcement proceedings, such as seizures against contaminated food, under the Federal Food, Drug, and Cosmetic Act, as amended. Losses to fishing and related industries are estimated by the state of Virginia to approach $4 million for the period July 1975 through December 1976.[40]

Several lawsuits are now pending on behalf of the affected workers and fishermen. A federal grand jury has indicted Allied Chemical Company, Life Sciences, Inc., the city of Hopewell, and company officials on more than 1,000 counts of criminal and civil violations of federal pollution control laws.

Although production of Kepone has ceased, pesticide products containing Kepone are still being formulated by other companies from existing stocks. In March 1976, EPA sent these formulating companies a notice of presumption against registration of pesticide products containing Kepone.[41] For carcinogenic chemicals, EPA registration procedures require such a notice under the 1972 pesticide law. The notice, which presumes such a chemical inappropriate for registration, gives the manufacturer an opportunity to "rebut" the presumption by presenting evidence that the risks are small or are outweighed by the benefits of use.

This specific incident was publicized within the last year, but there were many important events that occurred in earlier years. Several of these events are presented in Table I-15. This table shows clearly that key agencies and individuals lack coordination and knowledge of important available information, thereby permitting such problems to develop undiscovered.

FIFRA Renewal. Conflict over pesticide restrictions marked the debate on renewing authorization of the 1972 amendments to the 1947 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). On one side was the concern for higher farm production and economic benefits, and on the other side concern for health effects and the long-term integrity of the environment. The authorization for FIFRA expired in July 1975. After a 3-month renewal, FIFRA was reauthorized by Congress, with several amendments, on November 25, 1975, effective through March 31, 1977.[42]

The most significant changes in FIFRA instituted by the 1975 amendments involve procedures that EPA must follow in administering the act. In this regard, the amendments require EPA to allow the Secretary of Agriculture and a scientific advisory panel an opportunity to comment before action is taken on a proposed cancellation, change of pesticide classification, or regulation. Another amendment allows private applicators, under a state plan, to be self-certified.

EPA retains emergency powers. If the EPA Administrator determines that suspension of a pesticide registration will prevent an imminent hazard to human health, he is allowed to waive the requirements to consult with the Secretary of Agriculture or the scientific advisory panel.

Cancellations and Suspensions

Heptachlor and Chlordane. Pending the completion of cancellation hearings, several uses of the pesticides heptachlor and chlordane were suspended by EPA on December 24, 1975. A few specific uses are still permitted,[43] but most heptachlor and chlordane uses for corn and for home, lawn, and garden pests will be stopped. The human cancer hazard posed by these pesticides and the lack of benefits to outweigh this risk were the bases for their suspension.[44]

These compounds were the subject of an NCI Memorandum of Alert in October 1975, which reported preliminary findings of car-

TABLE I-15. Kepone-related incidents[a]

Year	Others	Allied Chemical Corporation	Life Sciences Products Company (LSP)	City of Hopewell, Virginia	State of Virginia	Environmental Protection Agency (EPA)	Occupational Safety and Health Administration (OSHA)
1959		Kepone first registered as a pesticide with USDA. Toxicity information included in registration shows Kepone causes "DDT-like tremors"					
1960 to 1972		Kepone found to cause growth and reproductive effects and tumors 1966: Manufacture begins at Allied plant in Hopewell				1971: EPA assumes responsibility for registration and regulation of pesticides from USDA	*December 1970:* Occupational Safety and Health Act creates OSHA
1973		Allied terminates Kepone production	LSP incorporates in Virginia and contracts with Allied to produce Kepone from raw material supplied by Allied, for sale exclusively to Allied, at the rate of 0.4 to 1.5 million pounds per year	*October:* Application to Water Control Board for a permit to discharge municipal waste water claims no industrial discharges enter sewage treatment plant			
1974			*February:* After citation for failure to obtain air pollution permit, LSP applies for and receives permit. Repeated violations of standard for particulates require installation of baghouse in October	*April:* After discovery that the sewage treatment plant is malfunctioning because of decimation of bacterial digesters by Kepone, Hopewell asks EPA for toxicity and treatment information	*February:* Virginia cites LSP for failure to obtain air pollution permit for SO_2 and particulates. (See LSP listing.) *October:* Water Control Board grants Hopewell waste water permit with no requirements for monitoring or limit on Kepone discharges, but solicits information and recommendations for treatment of Kepone contamination from EPA. (See Hopewell listing.)	*November:* EPA provides information requested by Water Control Board on toxicity of Kepone and recommends a limit of 0.4 part per billion in water for municipal plant intake	*September:* Former LSP employee files a complaint about working conditions at LSP. OSHA's toxicological information does not indicate severe hazard, so complaint handled as discrimination case
1975		*March 20:* Expecting new regulations, Allied applies for registration under FIFRA[b] of LSP as manufacturer of a pesticide				*March:* EPA begins to investigate whether LSP has violated FIFRA[b] requirement that all pesticide products and producers register with EPA	

	July: Hopewell physician submits blood sample of LSP employee to Center for Disease Control (Atlanta) for analysis. CDC finds Kepone blood level of 7.4 ppm and notifies Virginia Department of Health **August:** Washington Post reports illness of Kepone workers and LSP closing	**April 11:** Allied letter to EPA asserts that under existing regulations Kepone produced at LSP is a pesticide component; therefore, LSP is not subject to FIFRA's pesticide producer registration requirement	**July:** Virginia State Health Department orders LSP to stop production. Limited production continues into September **December:** EPA analyzes air samples obtained earlier by Air Pollution Control Board and finds Kepone among the pollutants collected	**April:** City agrees with Water Control Board to clean and repair water treatment facilities by June **June:** Above deadline not met	**June:** State amends Hopewell waste water permit to require pretreatment of effluents from LSP. Requirements apparently ignored **July:** Virginia Department of Health receives report of Kepone blood levels in LSP employees. State inspects LSP and orders it to close **December:** Governor of Virginia closes James River to fish and shellfish harvesting	**August:** EPA begins human and environmental sampling of Hopewell area **September:** EPA informs FDA of James River contamination **December:** EPA reports results of sampling program	**August:** OSHA officials first visit Hopewell, where Kepone production continues despite state order to close. OSHA cites LSP and the two LSP copartners for 4 violations, including failure to prevent employee exposure to harmful levels of Kepone. The total proposed penalty for the violation is $16,500
1976	**February:** Medical College of Virginia reports that 14 former LSP employees are probably sterile. National Cancer Institute releases study results indicating Kepone is carcinogenic **March:** FDA establishes action levels for seizure of contaminated fish and shellfish	**May:** Allied Chemical, Life Sciences, and the City of Hopewell are indicted in federal court on 1,096 criminal counts, including conspiracy to defraud EPA and violations of federal water pollution laws				**February:** EPA recommends action levels to FDA for seizure of contaminated fish and shellfish **March:** EPA sends formulators of Kepone-containing products a notice of presumption against registration of these products	**January:** OSHA reopens 1974 complaint of former employee of LSP

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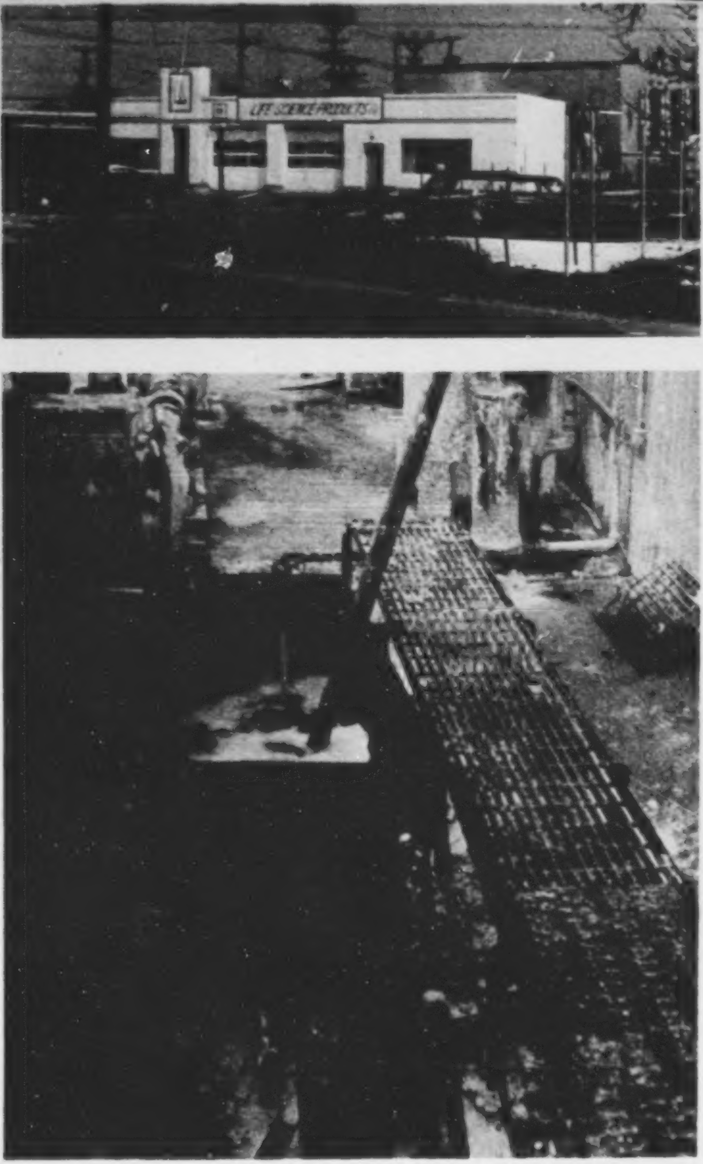
[a] Information obtained from EPA, Senate Agriculture and Forestry Committee (hearings before the Subcommittee on Agricultural Research and General Legislation, Jan. 22, 23, 26, and 27, 1976).

[b] Federal Insecticide, Fungicide, and Rodenticide Act, as amended.



(Top) Life Science Products in Hopewell, Virginia, produced Kepone until July 1975 when it was closed down by the state. (Bottom) The collection box shown has a drainpipe with cracks in its side, allowing Kepone to leak into the city's sewer system. Such contaminating conditions led to the poisoning of many of the plant's employees (Photo credit: Virginia State Department of Health, Dr. Robert S. Jackson) cinogenicity in tests underway at the Institute. EPA Administrator Russell Train's final order rejected the recommendation of an administrative law judge who concluded that evidence of cancer risks to human health was not "conclusive," and therefore insufficient for suspension.[45] In his decision, the Administrator determined that the evidence showing chlordane and heptachlor as carcinogenic required suspension under FIFRA, because the statutory standard hinges on the likelihood of unreasonable risk. The Administrator's decision was supported by previous decisions of the U.S. courts, which held that the agency is not required to establish a definitive risk of harm; instead, the burden is on the registrant to prove the safety of the product.[46]

Mirex. The pesticide Mirex ($C_{10}Cl_{12}$), chemically identical to Kepone except for one oxygen atom, is a concern because of its possible carcinogenicity. Mirex is used in Hawaii to prevent mealy bug wilt in pineapples and in the southern states to control fire ants. Substitute chemicals for fire ant control are limited.

Because of differences with EPA on the use of Mirex, the U.S. Department of Agriculture (USDA) temporarily halted and then reinstituted its fire ant eradication program.[47] Whether or not eradication is possible is a controversial issue, and so is the potential adverse impact of Mirex on the environment. Allied Chemical Company, the sole producer of Mirex, has discontinued production. However, under initiatives mounted by USDA and certain southern states, the state of Mississippi has purchased the Allied Chemical plant in order to produce it.[48]

The hearings on this pesticide began in December 1973, and are expected to conclude early in 1977 with a recommendation by an administrative judge as to whether greater or fewer restrictions should apply to it.

Mercury. Mercury-based pesticides are used widely as mildewcides in paints and textiles, as seed treatments, and as fungicides to control turf diseases, etc. The consumption of contaminated seafood from waterways in which mercury compounds were dumped has poisoned many persons, resulting in severe nerve disorders, brain damage, birth defects, and in some cases even in death (e.g., the Minamata incident). Other well documented causes of human poisonings are occupational exposure and accidental consumption of seed grain. Mercury compounds are also toxic to birds and aquatic species down the entire food chain.[49]

Mercury-based pesticides were the subject of administrative hearings for about 1 year. The hearings were ended by EPA in November 1975, and a February 17, 1976, Opinion and Order concluded that the risks of continued use of mercury-based pesticides outweighed any benefits. The Opinion and Order cancelled all mercury pesticide registrations except treatment of textiles and fabrics intended for continuous outdoor use, control of brown mold on freshly sawed lumber, and treatment for control of Dutch elm disease.

Mercury introduced into the U.S. environment by pesticides would have been reduced by 98.5 percent. However, at the request of several paint manufacturers, the EPA Administrator agreed to reconsider his decision to cancel the use of mercury in water-based paints, which comprises about 55 percent of mercurial pesticide use. In a final decision issued May 27, 1976, the Administrator reversed the cancellation for water-based paints to allow their continued use on the grounds that nonmercurial substitutes for water-based paints are not available. All other cancellations will become effective November 30, 1976. The final decision will reduce by 25 percent the amount of mercury pesticides released into the environment (based on 1973 data).[50]

Registration of New Products. The adverse effects of pesticide chemicals on nontarget species and the necessity to curb their use have prompted a search for new products that offer improved pest control with reduced environmental risk. Among those approved for use in the past year and a half are:

- An insecticide made from a natural insect virus for use against two pests: the cotton bollworm and the tobacco budworm.[51] This virus is not known to be hazardous to persons applying it or to nontarget insects, birds, and wildlife, nor does it accumulate in animal tissue.
- Two juvenile hormone insecticides.[52] Juvenile hormones similar to natural insect hormones disrupt normal development processes, thus rapidly destroying large parts of the insect populations. They attack only the target pests, dissipate rapidly after release into the environment, and are very active in minute quantities.
- An encapsulated, slow-release form of methyl parathion.[53] Methyl parathion is a widely used organophosphate pesticide with a high acute toxicity, but short lifetime in the environment. Slow-release mechanisms, by allowing long-term effectiveness of otherwise short-lived pesticides, reduce the number of applications needed, and thus the total environmental and occupational exposure.

Boll Weevil Eradication Program. An ambitious USDA trial program to eradicate the boll weevil from a quarter of a million acres in North Carolina, South Carolina, and Virginia is scheduled to begin this year.[54] However, there is controversy over whether this important cotton pest can be eliminated. Cost estimates for a full-scale program, if trials are successful, range from $655 million to $1.5 billion.

The proposed pest control program includes up to 18 applications of chemical insecticide and cropping practices in the first year. Pheromone (sex attractant) traps and the release of sexually sterile male boll weevils will be emphasized during the second and third years of the program, provided that the measures in the first year succeed in bringing the boll weevil population down to a low level.

AID Pesticide Environmental Impact Statement. In April 1975, the Environmental Defense Fund, Inc., et al., filed a complaint against the Agency for International Development (AID). The complaint was filed on the grounds that AID had not prepared an impact statement regarding its role in helping foreign governments procure and use pesticides (including those banned in the United States), and therefore that it failed to comply with the requirements of the National Environmental Policy Act of 1969. The case was settled by a stipulation that required AID inter alia to prepare an impact statement on its pest management program abroad and to issue interim regulations regarding procurement and use of pesticides.[55]

These interim regulations, issued December 31, 1975,[56] require that AID not provide assistance for the procurement and use of DDT; aldrin; dieldrin; 2,4,5-T; heptachlor; chlordane; any unregistered pesticide; any unregistered use for a pesticide; any suspended or cancelled pesticide; or any pesticide for which EPA has given notice of intent to suspend, anytime 60 days after the notice is announced.

Under the interim regulations, there are special cases in which AID can use a pesticide normally restricted from use:

- If the benefits outweigh the potential adverse effects and no alternative is available.
- If a significant health problem will occur without its use.
- If an emergency exists.
- Under certain circumstances, if it will be used on agricultural crops or disease vectors not found in the United States.

AID will consult EPA on all special uses, except in the case of special health problems. Final regulations will be issued after the impact statement has been completed.

Other Hazardous Substances

Cancer Alerts. Increasing knowledge of the role of chemicals in causing cancer emphasizes the need for a system to provide early warnings of potential hazards. During the last year, the NCI and the National Institute for Occupational Safety and Health (NIOSH) have initiated early warning systems for possible carcinogens. NCI and NIOSH have alerted producers and regulators to newly discovered health hazards for 11 substances, as summarized in Table I-16. All but one exception (shown with an asterisk) are believed to be carcinogens.

These 11 substances range from solvents used to decaffeinate coffee to the asbestos used in auto brake linings. Typically, workers suffer the greatest exposure to these materials, but consumers and the general population can also be exposed. For instance, chloroform is used in cough syrups, mouthwashes, and toothpastes, and has appeared in tap water at levels as high as 366 micrograms per liter.

TABLE I-16. NIOSH alerts[a]

Substances	Date of NIOSH bulletin	Uses	Number of workers potentially at risk	Status of occupational standard	Other exposure standards	Comments
Chloroprene	1/20/75	Production of synthetic rubber	2,500	TLV	None	
Trichloroethylene[b]	6/6/75	Industrial solvent (dry cleaning, metal degreasing) extraction of caffeine from coffee, anesthetic	200,000	TLV proposed as permanent standard 10/20/75 (40 Fed. Reg. 49031)	FDA standards permit up to 10 ppm in ground coffee and up to 25 ppm in instant coffee (21 C.F.R. 121.1041)	In June 1975, the Health Research Group petitioned FDA to ban decaffeinated coffee containing trichloroethylene (Petition No. 75P-0132, acknowledged June 27, 1975). CPSC is preparing a monograph on consumer exposure
Ethylene dibromide[b] **(EDB)**	7/7/75	Leaded gas additive	650,000 service station personnel	TLV	None	Limited sampling of EDB by an EPA contractor found low levels in air and water at gas stations and 2 manufacturing sites. EDB is believed not to accumulate in the environment but to degrade at moderate rates in soil and water. An EPA report concludes that these low levels do not represent a significant health risk, and that increased use of unleaded gas since 1975 will reduce any possible risk from EDB added to gasoline.[c] The Environmental Defense Fund has petitioned EPA to investigate the possible health risk of EDB residues in fumigated grain, which have been detected at levels up to 6.10 ppm[d]
		Manufacture of dyes and pharmaceuticals	214 in manufacturing and merchandising			
		About 100 pesticide products	8,897 fumigators			
Asbestos	8/8/75	Brakes and clutch assemblies	833,535 auto workers 67,679 garage workers 6,657 manufacturers	1974 permanent standard; more stringent standard proposed 10/9/75 (40 Fed. Reg. 47651)	EPA hazardous air pollutant standard (40 C.F.R.61)	The asbestos alert supplements the current occupational standard which applies to all work places but was primarily aimed at fabrication facilities and the construction trades, by calling attention to new data concerning the special hazard from asbestos exposure among workers who service brakes and clutch assemblies. A review of scientific literature on mesothelioma, a cancer of the lining of the abdominal cavity that is associated with asbestos exposure, has revealed at least four cases of these otherwise rare tumors in persons who had worked in jobs involving brake servicing. To protect an estimated 908,000 auto mechanics, garage workers, and fabricators, NIOSH has recommended interim procedures to minimize their exposure while alternatives are studied

Chromate compounds	8/22/75	Paints and anticorrosives.	1,000 in production of pigments. 65,600 in paint manufacturing. 487,000 painters and persons using chromate paint primers.	TLV	None	An October 1975 U.S. steelworkers petition to OSHA for a zero exposure emergency temporary standard was denied on April 29, 1976.[e] OSHA intends to begin a rulemaking procedure to establish an occupational exposure standard for hexavalent chromium. NIOSH recommended an exposure standard not greater than 1 $\mu g/m^3$ for carcinogenic chromium compounds and 25 $\mu g/m^3$ for noncarcinogenic compounds (41 Fed. Reg. 18869-18870, May 7, 1976).
Hexamethyl phosphoric triamide (HMPA)	10/24/75	Solvent used in research labs.	5,000	None	None	
Polychlorinated biphenyls	11/3/75	Coolants and insulators in heavy electric equipment; hydraulic fluids, pesticide extenders, inks, etc.	12,000	TLV	FDA limits in food and food packaging (21 C.F.R. 122.10).	See text.
4, 4-Diamino-diphenyl methane (DDM)	1/30/76	Production of polyurethane.	2,500	None	None	
Chloroform[b]	3/15/76	Production of fluorocarbons, general solvent in preparation of dyes, drugs, pesticides, etc. Used in pesticides, cough and cold preparations (mouth wash, toothpaste, etc.), as an anesthetic, and as common laboratory solvent.	40,000	TLV	None	On March 11, 1976, Nader's Public Citizens Health Research Group filed suit in the U.S. District Court of Appeals for the District of Columbia to order FDA to recall more than 2,000 drugs and cosmetic products containing chloroform. In April, FDA proposed two new regulations that would ban chloroform in these products. Regulations were finalized June 29 with July 29, 1976, as the effective date. The ban does not recall items already on the market (41 Fed. Reg. 12842).
***1,-2-Bis(ethylsulfonyl)-1,2-dichloroethylene**	3/26/76	None	None	None	None	Eye irritant; considered as a possible substitute for mercurial fungicides.
Dimethyl carbamoyl chloride (NMCC)	4/15/76	Synthesis of pharmaceuticals, chemical research.	Less than 200	None	None	

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[a] Except one (as noted) all of these are known or suspected carcinogens. The one exception is indicated by an asterisk.

[b] Substance was also the subject of an NCI memorandum of alert.

[c] U.S. Environmental Protection Agency, *Sampling and Analysis of Selected Toxic Substances; Task 2 Ethylene dribromide* (Springfield, Va.: National Technical Information Service, 1975).

[d] Petition to Russell E. Train, EPA Administrator, July 14, 1975.

[e] Letter from Morton Corn, dated April 29, 1976.[106]

Lead. Lead, one of the earliest recognized hazardous substances, is still a ubiquitous problem. Once lead enters the body, it can cause anemia and severe intestinal cramps and, at higher concentration, permanent nerve damage and death. Leading sources of human exposure are ingestion by young children with pica (abnormal craving for nonfoods) who eat leaded paint and dirt; on-the-job exposure of at least 1 million workers in industries such as smelting and battery-making; airborne lead from nonferrous metal smelters for persons living nearby; or auto exhausts near highways.

Lead Paint. The Lead-Based Paint Poisoning Prevention Act of 1974[57] specifies that fresh paint used for household interiors should contain no more than 0.06 percent lead, unless the Chairman of the Consumer Product Safety Commission (CPSC) determines that some other level (not to exceed 0.5 percent) is safe. The Consumers Union has challenged Chairman Richard Simpson's determination,[58] made in January 1975, that 0.5 percent is safe. Arguments in the case were completed in September 1975.

The challenge relies heavily upon the opinion of the U.S. Department of Health, Education, and Welfare (HEW) that it is impossible to establish a safe level for lead in paint, and that 0.06 percent is readily achievable.[59] Some of the other CPSC commissioners dissented from the opinion of Chairman Simpson, and in June 1976 Congress passed legislation to give the commission full authority to make the determination.[60]

Occupational Lead. A high incidence of lead poisoning among workers at two secondary smelting plants in Indianapolis, Indiana, was uncovered in a study sponsored by the U.S. Steelworkers Union.[16] About 100 of the 158 workers examined showed symptoms of neurological disturbance; other symptoms included anemia, hypertension, colic, and kidney damage. Most workers had abnormally high levels of lead in their blood. Exposures in these plants were above the standard of 200 micrograms per cubic meter ($\mu g/m^3$) of ambient air set by the Occupational Safety and Health Administration (OSHA); however, OSHA had granted the plants a delay in reaching the standard. OSHA is proposing to cut permissible exposures from 200 to 100 $\mu g/m^3$.[62]

The study also found that the plant management had routinely given powerful drugs—EDTA salts, and/or penicillamine—to workers exposed to high lead concentrations. These drugs are chelating agents, i.e., they bind to metals and thereby aid their excretion. According to FDA requirements, EDTA salts should be used only for emergency treatment of heavy metal poisonings. Routine use, which lowers blood levels of essential trace metals as well as lead, gives the appearance of low-level exposure, but can cause adverse side effects such as kidney damage.

The package label includes a warning required by the FDA stating that EDTA salts are capable of producing toxic and potentially fatal effects and that chronic use should not serve as a substitute for adequate ways to avoid undue exposure to lead. The prophylactic use of this drug in the Indianapolis plants has been described by NIOSH as "unacceptable medical practice" [63] and as "unethical and immoral" by the American Occupational Health Association.[64]

The drug apparently did not prevent lead poisoning in the persons studied; workers with blood levels that tested low for lead still showed symptoms of neurologic and metabolic impairment.

Airborne Lead. A court decision on the regulation of lead in gasoline has strengthened policies that protect public health by means of preventive action. In December 1973, EPA declared a limit on the lead content of gasoline which would lower the permissible level to 0.5 gram per gallon by 1979, based upon public health considerations.[65] A three-judge panel of the U.S. Circuit Court of Appeals for the District of Columbia set aside the regulations in December 1974 for lack of a definitive scientific basis. After a rehearing by the full nine-judge circuit court, on March 19, 1976, the court ruled, five to four, that under Section 211 of the Clean Air Act, EPA is empowered to undertake protective public health measures without necessarily establishing a "rigorous step-by-step proof of cause and effect." [66]

A second important judicial decision requires EPA to classify airborne lead as a pollutant under Section 108 of the Clean Air Act. The March 1976 decision by the U.S. District Court for the Southern District of New York [67] ruled that even though EPA tries to limit airborne lead under other provisions of the act, once the agency determines that a substance has an "adverse effect on health" and that it comes from diverse sources, it must be listed as a pollutant under Section 108. By law, an ambient air quality standard must be proposed within 1 year after a substance has been so classified.

Fluorocarbons. Two years have passed since it was first proposed that certain fluorocarbons released to the environment may modify the ozone layer in the stratosphere, thereby increasing the harmful solar radiation reaching the surface of the Earth. Ultraviolet radiation from the sun is known to cause skin cancer in humans, and any significant increase in the radiation is feared to threaten agricultural or ecological systems and possibly the climate.

Fluorocarbons are used in various ways, including as a propellant in about half of all aerosol cans and as the principal fluid in air conditioner and refrigerator coils. In June 1975, an ad hoc Federal Interagency Task Force on Inadvertent Modification of the Stratosphere (IMOS) concluded that the issue was a "legitimate cause for concern" and that fluorocarbons-11 and -12 may have to be restricted, e.g., to replacement in existing air conditioning and refrigeration equipment. The task force called for initiation of proposed rulemaking if a further study by the National Academy of Sciences (NAS), originally scheduled for April 1976, confirmed the seriousness of the problem.[68] For certain uses, such as industrial solvents and foaming agents, legislation to supplement existing laws will be necessary before such sources of emissions can be controlled.

In further developments since the IMOS report:

- A three-to-two decision of the CPSC in July 1975 denied a petition from the NRDC to initiate hearings into the possible banning of all aerosol consumer products containing fluorocarbon propellants.[69] CPSC has delayed its decision on a second petition by NRDC and ten states pending the outcome of the NAS study.[70]
- Oregon has banned the sale of aerosol products containing certain fluorocarbons effective March 1977. The state of New York has imposed a similar ban, to take effect in January 1978, if the Environmental Conservation Commissioner finds a threat to public health. The state has issued labeling requirements for aerosol products containing the chemicals, effective April 1, 1976.[71] Several other states are considering similar legislation.
- Both the House and Senate are considering fluorocarbons-specific legislation as part of the amendments to the Clean Air Act. Basically, each version requires EPA to study fluorocarbons and other emissions that could affect the stratosphere, and authorizes EPA to propose controlling regulations if the substances are determined to pose such a hazard.[72] The pending toxic substances control legislation also would be applicable to these compounds. This legislation is discussed in more detail at the end of this section.
- Several atmospheric and laboratory measurements made since June 1975 have refined specific estimates of predicted ozone reduction, and are consistent with the hypothesis of stratospheric ozone reduction by fluorocarbons-11 and -12.[73]
- EPA has requested producers of pesticides to find alternative propellants. Only about 900 of the 10,000 currently registered pesticide aerosols (about 200 million containers) contain fluorocarbons; they contribute less than 1 percent of the total amount of fluorocarbons released to the atmosphere.[74]
- The 24-nation Organisation for Economic Co-operation and Development is undertaking a major effort to study patterns of fluorocarbon use and worldwide production and to evaluate international regulatory options. Thus, it is hoped, if regulation of any fluorocarbons becomes necessary, actions can be coordinated on a worldwide basis. Several other international organizations (UN Environment Programme, World Meteorological Organization, and others) are studying the issue or sponsoring relevant research. The State Department is coordinating U.S. participation in these activities.
- The study being conducted by the NAS, originally scheduled for completion in April 1976, was delayed to incorporate several new scientific findings.

Fluorocarbons used as propellants in about half of all aerosol products are a concern because of possible harmful effects upon the stratospheric ozone layer (Photo credit: Council on Environmental Quality, Julie Lee)

- With congressional approval, a research program into the biological and climatic effects of stratospheric ozone reduction is being initiated in FY 1977. This program is initially designed to obtain more information about the effects of increased ultraviolet radiation within the decisionmaking timeframe for fluorocarbons.

Zirconium. Other aerosols containing zirconium compounds (used as a perspiration inhibitor in some underarm deodorants) apparently cause lung diseases when inhaled by test animals. Because of the small benefit from this use of zirconium compounds, the U.S. Food and Drug Administration (FDA) proposed regulations in June 1975 to prohibit the use of zirconium in aerosol drugs and cosmetics. Most manufacturers of aerosol antiperspirants, however, had taken zirconium out of their products prior to final rulemaking this year.[75]

Vinyl Chloride. Vinyl chloride is a gas used in the manufacture of polyvinyl chloride, the most commonly used clear plastic. Exposure to vinyl chloride is known to cause cancer. Studies have also suggested that increased rates of birth defects occur in communities where polyvinyl chloride manufacturing plants are located.[76] An estimated 100 million kilograms (220 million pounds) of vinyl chloride was released into the atmosphere by U.S. plants in 1974.[77]

Monitoring data in the populated areas around plants producing ethylene dichloride, vinyl chloride, and polyvinyl chloride indicate that average exposures are less than 1 ppm; however, peak exposures of 33 ppm have been observed. Most plants that emit those pollutants are not isolated from surrounding populations. About 4.6 million persons live within 5 miles of the production facilities.

The U.S. Department of Labor established an occupational exposure limit of 1 ppm for vinyl chloride in 1974.[78] EPA classified it as a hazardous pollutant under the Clean Air Act on December 24, 1975, the fourth pollutant to be so designated. (The others are mercury, asbestos, and beryllium.)

EPA proposed a best available control technology strategy, designed to reduce aggregate national emissions by at least 90 percent. Such action would limit to 10 ppm the source strength of vinyl chloride emissions. This limit, together with atmospheric dilution, is intended to protect anyone living near a vinyl chloride or polyvinyl chloride plant.

The standards apply to 58 existing plants around the country and also to new plants. The vinyl chloride emissions from the 58 plants account for 95 percent of the present nationwide total. The rest occur at about 8,000 plastic product fabricating plants, where emissions are generally much lower.[77]

In September 1975, FDA proposed to ban the use of rigid and semi-rigid, generally clear, vinyl chloride plastics that come in contact with food. Because pliable wraps, cap liners, package coatings, etc., have undergone more heating and plasticizing, unreacted vinyl chloride residues are expected to be much lower in these products, and therefore less likely to migrate into food. Use of these products would not be affected under the FDA proposal.[79]

PCBs. Despite federal efforts and voluntary cooperation by the manufacturer, PCBs are a continuing serious problem. At the time of a federal task force report in 1972,[80] this class of chlorinated hydrocarbon fluids was widely used in ink solvents, plasticizers, adhesives, textile coatings, and other products. Because of the persistence of PCBs in the environment and their toxic effects on a variety of species, the task force recommended that PCB uses be restricted to closed system electrical equipment. The sole U.S. producer, the Monsanto Company, accordingly volunteered to limit sales to uses in insulating electrical transformers and capacitors. EPA issued guidelines to limit PCBs in water, and FDA established temporary tolerances to limit unavoidable residues in food and animal feed. Subsequently, the Organisation for Economic Co-operation and Development adopted a resolution aimed at limiting trade in and use of PCBs between and within member countries (see the International Events section of this chapter).

However, imported and processed PCBs are still sold for purposes other than closed electrical systems. These uses include investment casting processes, heat exchange fluids, hydraulic fluids, and ink solvents. Monitoring data indicate that environmental contamination continues at or above the 1972 levels.[81] In addition:

- Feeding studies on primates have shown hair loss, skin lesions, liver changes, and reproductive losses.[82]
- Feeding tests using rodents show that PCBs may be carcinogenic.[83]
- A General Electric official testifying at hearings held by the New York State Department of Environmental Conservation reported that at least 65 employees exposed to PCBs have suffered nausea, dizziness, eye irritation, nasal irritation, asthmatic bronchitis, dermatitis, fungus, and acne.[84]
- PCBs have been found in low concentrations in the drinking water of five cities.[85]
- PCB levels exceeding the FDA temporary tolerance of 5 ppm are being found in certain species of freshwater fish taken from the Great Lakes, the upper Mississippi, the Hudson River, and other waters in the United States.[86]
- The New York Environmental Conservation Commissioner has banned most commercial fishing in the Hudson River[87] because FDA and state tests show that most fish from these waters contain PCBs in excess of the FDA tolerance. These PCBs averaged 31.3 ppm in 68 FDA samples and 94.66 ppm in samples taken by General Electric downstream of its plant.[86]
- The states of Indiana and Michigan have laws restricting the manufacture, sale, and uses of PCBs.[88] Illinois, Minnesota, New York, and Wisconsin are considering similar legislation.

A phaseout of all PCB uses other than those which EPA finds would entail no unreasonable risk is contained in the toxic substances control legislation passed by the Senate.[89] In the meantime, EPA has taken these steps:[90]

- Directed regional offices, in cooperation with the states, to establish requirements under the NPDES to eliminate PCBs from the process wastes of manufacturers of capacitors and transformers.
- Asked electric utility companies and other users of large capacitors and transformers, such as railroads, to control the use and disposal of their PCBs.
- Initiated research into ways of eliminating discharges from other sources such as paper recycling, investment casting industry, and disposal of electrical consumer products that contain PCBs.
- Asked manufacturers of PCBs, transformers, and capacitors to develop safe and environmentally acceptable alternatives.
- Proposed regulations to control the environmental damage that results from spills.[91]
- Asked state governors to "examine and apply their authorities to deal with the problem."
- Asked federal agencies to inventory their uses of PCBs and PCB-containing material and to develop plans to ensure adequate management and safe disposal.

Several chemical manufacturers have announced the development of potential substitutes.[92] Data on their chemical and biological properties have been requested by EPA. Monsanto has announced that it intends to phase out production of PCBs as soon as it is satisfied that suitable dielectric fluids are available to the electrical power supply industry.[93]

PCBs are an example of substances for which a new regulatory approach is needed. Existing laws to control sources apply essentially to the media in which a pollutant occurs—to ambient levels and direct air and water discharges. These laws can be used to limit the direct discharges from point sources (about 10,000 pounds per year). However, the laws only partially control the ultimate discharge of 35 to 40 million pounds of domestically produced PCBs, and 1 million pounds of imported PCBs, annually being used in electrical equipment, hydraulic equipment, paper products, and other commercial and industrial products. Enactment of the toxic substances control legislation would control PCBs not only through their discharge from manufacturing, but also through their use.

Nitrosamines. Nitrosamines occur throughout the environment, in foods, drugs, tobacco, drinking water, and even air. Direct discharges from manufacturing processes are a source, but they can also be generated by the reaction of secondary amines and nitrite ions under acidic conditions—the reactions of natural amines, such as amino acids in food, with nitrogen compounds emitted from automobiles, powerplants, or commercial fertilizers. Laboratory tests have shown some nitrosamines to be strongly carcinogenic or mutagenic.

Researchers in September 1975 found nitrosamines in the air of Baltimore, Maryland, and Belle, West Virginia. Very high levels, up to 15 times higher than expected, were reported around a Baltimore chemical plant manufacturing dimethyl hydrazine, a rocket fuel produced for the U.S. Air Force. Dimethyl nitrosamine, a potent carcinogen, was being used as an intermediate in the production of the fuel. After the state of Maryland ordered the plant to show cause why it should not be shut down until pollution control devices could be installed,[94] the chemical plant announced that it would discontinue production by April 1976.

Nitrate and nitrite salts have commonly been used in meat and poultry products to inhibit botulinal bacteria and to enhance color. Nitrosamines formed from these preservatives in food have long been under investigation by FDA and USDA. An Expert Panel on Nitrites and Nitrosamines, appointed in 1973 by the Secretary of Agriculture, has recommended reducing or eliminating the use of nitrate and nitrite salts in curing meat products. This panel reported a special problem with bacon, in which nitrosamines form in the range of 10 to 20 parts per billion (ppb) during frying.

Accordingly, on November 11, 1975, USDA proposed regulations that, if adopted, would stop the use of most nitrates and reduce permissible nitrite levels in most cured meats and poultry products.

The maximum amount of nitrite permitted to be added to bacon would be 125 ppm, pending additional research by USDA, FDA, and the industry into alternative processing procedures. A report on this work is expected by November 1976.[95]

Diethylstilbesterol (DES). FDA proposed on January 12, 1976, to withdraw approval of the synthetic estrogen DES used as a growth stimulant in food animals. The proposal was made on the grounds that residues found in meat are a cancer hazard and that continued approval of the drug is, therefore, unlawful under 1958 and 1962 "Delaney amendments" to the Federal Food, Drug, and Cosmetic Act.[96] DES used in the 1940's and 1950's to prevent miscarriages in pregnant women has since been associated with vaginal cancer in their daughters and recently with sterility in their sons.

Under the 1962 amendment, known carcinogens may be used as animal drugs only where no harm results to the animal and where no residue is found in edible portions after slaughter using detection methods prescribed by FDA. The method of detection is thus a crucial element in the regulation.

In 1963, FDA approved two methods for measuring DES residues: one that detects DES at levels down to 2 ppb, and a less sensitive method that cannot differentiate DES at levels below 10 ppb. DES has been carcinogenic in test animals at the lowest dose tested to date, 6.25 ppb.[96]

After USDA discovered residues by means of a third detection method, FDA withdrew approval of DES in 1973. The action was vacated by the U.S. Court of Appeals for the District of Columbia on the grounds that FDA had not afforded adequate opportunity for hearing.[97]

USDA still found residues in 1974 and 1975, and FDA finally concluded that "currently approved methods for DES have been shown to be inadequate to detect significant residues," and that "the central assumption underlying the previous approvals by FDA of DES . . . is no longer valid." [96]

DES has recently been used as a "morning after" pill, authorized by FDA in dosages of less than 25 milligrams for emergencies such as rape.[98] The current ban would not apply to this use.

FDA is now investigating reports associating other synthetic estrogens used for contraception and medical purposes, such as treatment of postmenopausal symptoms, with an increased risk of breast and uterine cancer.

Nitrofurans. On May 13, 1976, FDA proposed a ban on the use of furazolidone, another drug in animal feed. The action was made on the grounds that furazolidone has been shown to induce cancer when ingested by animals and that there is no adequate, reliable, and practicable method of analyis for ensuring that residues of the drug will not be found in any edible portion of animals.

This proposed ban is the first of four anticipated proposals covering nitrofuran antibiotics used in animal feed to promote growth by retarding disease. These actions update a 1971 proposed ban on furazolidone, nitrofurazone, nihydrozone, and furaltadone which was never finalized by FDA. Furazolidone was first approved in 1953.[99]

Asbestos in Lake Superior. Since February 1972, the federal government, environmental groups, and states adjoining Lake Superior have been involved in a suit against Reserve Mining Company of Silver Bay, Minnesota, because of its daily discharge of 67,000 tons of asbestos laden tailings into the lake. Asbestos-like fibers from the tailings have appeared in the drinking water of Duluth and adjoining cities. Inhalation of asbestos is known to cause cancer; the effects of ingesting it are unknown.

In its decision in March 1975,[100] the U.S. Court of Appeals for the Eighth Circuit found that these discharges violated various state and federal laws, but ruled that the danger to the residents of the north shore is a "potential" rather than an "imminent" health hazard. The court instructed Reserve Mining Company and the state to agree on a suitable onland disposal site within a reasonable time, and granted the company a further reasonable time to convert to onland disposal, stipulating that if no site were agreed upon, the company must close within 1 year.

During the past year, the following events have occurred:

- Responding to a petition by Reserve Mining Company, the U.S. Court of Appeals for the Eighth District removed Judge Miles Lord of the district court from the case on the grounds that he was no longer acting impartially and had assumed the role of an environmental advocate.[101] Chief Judge Edward J. Devitt of the district court assumed jurisdiction over the remaining legal issues.
- In his first action since assuming the case, Judge Devitt ruled on February 21, 1976, that Reserve Mining Company must reimburse the U.S. Army Corps of Engineers for expenses incurred to date in providing free filtered water to the residents of Duluth and the surrounding area. The Corps has maintained the temporary filtration system under court order since 1974 at a cost of about $288,800 and will continue to do so until a permanent facility is completed by the city of Duluth, scheduled in spring 1977. A concomitant request for advance payment of approximately $6 million to defray the Corps' anticipated expenses through April 1977 was denied.[102]
- On May 4, 1976, Judge Devitt assessed Reserve Mining Company fines totaling more than $1 million—$837,500, for violating state water discharge permits, May 20, 1973, to April 20, 1974; $200,000 for withholding information earlier in the lawsuit; and an additional $22,920 to reimburse Duluth for its costs thus far in supplying filtered water to residents.[103]

- The state of Minnesota has authority to issue permits for any land disposal site for the tailings. Under a March 1975 ruling by the U.S. Court of Appeals for the Eighth Circuit, the state and Reserve Mining Company were given "a reasonable time" to reach agreement upon a site or the company would face a possible shutdown. Reserve Mining Company petitioned for disposal at milepost 7 along the company-owned railroad line in Silver Bay, Minnesota, 7 miles from the plant. After extensive hearings and the preparation of a detailed environmental assessment, however, the state hearing officer and the Minnesota Department of Natural Resources recommended in May 1976 that the tailings be disposed of at milepost 22, approximately halfway between Reserve Mining's mine in Babbitt, Minnesota, and its Silver Bay processing plant. The examiner determined that the milepost 7 disposal site would cause pollution, impairment or destruction of the air, water, land, and other natural resources located within the state. On July 6, 1976, Judge Devitt ruled that, without an approved site, Reserve Mining Company cannot continue to operate and must be shut down no later than 1 year from that date. The company expects to appeal the decision.

Occupational Health

Health Standards. Progress continues to be slow in implementing new workplace standards under the 1970 Occupational Safety and Health Act.[104] Section 6(a) of the act requires OSHA to adopt "consensus standards" under abbreviated rulemaking procedures within 2 years of the date of enactment. Consensus standards reflect guidelines and practices already adopted by industry, government agencies, and other affected parties. Approximately 400 such standards were adopted, chiefly comprising maximum 8-hour average atmospheric concentration for the specified substances, or "threshold limit values" (TLVs).

Section 6(b) permits OSHA to modify or revoke existing standards, or to develop new ones, but requires lengthier rulemaking procedures than under Section 6(a). Under Section 6(c), for cases in which workers are subject to imminent hazard, OSHA can impose emergency temporary standards that become effective immediately upon publication in the *Federal Register*.

Permanent standards under Section 6(b) are generally proposed by OSHA on the basis of recommendations and research conducted by NIOSH. This research is transmitted by NIOSH to OSHA in the form of "criteria documents," prepared for individual substances. Table I-17 is a list of 32 criteria documents prepared thus far.

Only three sets of exposure standards (for asbestos, vinyl chloride, and a group of 14 carcinogens) have been completed under Section 6(b) since 1970; these standards are listed in Table I-18. All were preceded by emergency temporary standards. Eleven additional permanent standards covering a variety of hazards have been proposed; they are summarized in Table I-19.

A petition by the U.S. Steelworkers of America for an emergency temporary standard for chromate pigments was refused on April 29, 1976[105] in favor of a regular rulemaking proceeding under Section 6(b).

TABLE I-17. NIOSH criteria documents (with year of transmittal)

- Ammonia (1974)
- Arsenic (inorganic) (1975)
- Asbestos (1972)
- Benzene (1974)
- Beryllium (1972)
- Carbon monoxide (1973)
- Carbon tetrachloride (1976)
- Chromic acid (1973)
- Chromium (hexavalent) (1976)
- Chloroform (1974)
- Coke oven emissions (1973)
- Cotton dust (1974)
- Ethylene dichloride (1976)
- Fluorides (inorganic) (1976)
- Hazardous materials labeling (1975)
- Heat stress (1976)
- Hydrogen fluoride (1976)
- Isopropyl alcohol (1976)
- Kepone (1976)
- Lead (inorganic) (1973)
- Mercury (inorganic) (1973)
- Oxides of nitrogen (1976)
- Phosgene (1976)
- Radiation (ultraviolet) (1973)
- Silica (crystalline) (1974)
- Sodium hydroxide (1975)
- Sulfur dioxide (1974)
- Sulfuric acid (1974)
- Toluene (1973)
- Toluene diisocyanate (1973)
- Trichloroethylene (1973)
- Xylene (1975)
- Zinc oxide (1975)

TABLE I-18. Exposure standards completed

Substance	Eight-hour exposure limit	Date
Asbestos	Five fibers per cubic centimeter	June 7, 1972 (37 Fed. Reg. 11318)
14 carcinogens	None	Jan. 29, 1974 (39 Fed. Reg. 3756)
2-Acetylaminofluorene		
Alpha-naphthylamine		
4-Aminodiphenyl		
Benzidine		
Beta-naphthylamine		
Beta-propiolactone		
Bis-Chloromethyl ether		
3,3′-Dichlorobenzidine		
4-Dimethylaminoazobenzene		
Ethyleneimine		
Methyl chloromethyl ether		
4,4′-Methylene bis(2-chloroaniline) (MOCA) •		
4-Nitrobiphenyl		
N-Nitrosodimethylamine		
Vinyl chloride	1.0 part per million	Oct. 4, 1974 (39 Fed. Reg. 35890)

• The MOCA standard was set aside on procedural grounds on December 17, 1974, by a court order. It was proposed again on February 3, 1975 (40 Fed. Reg. 4932).

TABLE I-19. Exposure standards proposed

Substance	Exposed population	Health effects	Date proposed
Arsenic	1,500,000	Cancer (lung, skin), acute poisoning	Jan. 2, 1975 (40 Fed. Reg. 3391)
MOCA[a] 4,4'-Methylene bis (2-chloraniline) (reproposed)	?	Cancer	Feb. 3, 1975 (40 Fed. Reg. 4932)
Coke oven emissions	5,000	Cancer (lung, colon, kidney, leukemia)	July 31, 1975 (40 Fed. Reg. 32267)
Lead (inorganic)	At least 1 million	Damage to the central nervous system, kidneys, blood-forming process	Oct. 3, 1975 (40 Fed. Reg. 45933)
Toluene	100,000	Mental confusion, decreased coordination	Oct. 6, 1975 (40 Fed. Reg. 45933)
Asbestos (proposed revision more stringent)	90,000 fabricators; up to 5 million in construction and associated trades	Cancer, lung disease	Oct. 9, 1975 (40 Fed. Reg. 47651)
Beryllium	30,000	Cancer (lung), lung disease, skin disease, other systemic effects	Oct. 17, 1975 (40 Fed. Reg. 48813)
Trichloroethylene	288,000	Depression of the central nervous system; toxic effects on cardiovascular system, liver, kidney; skin rash, cancer	Oct. 20, 1975 (40 Fed. Reg. 49031)
Sulfur dioxide	500,000	Lung disease; eye and upper respiratory irritation; promotion of cancer	Nov. 24, 1975 (40 Fed. Reg. 54519)
Ammonia	An unknown number in the fertilizer and chemical industries	Irritation of the eyes and respiratory tract	Nov. 25, 1975 (40 Fed. Reg. 54683)

[a] The MOCA standard was set aside on procedural grounds on December 17, 1974, by a court order. It was proposed again on February 3, 1975 (40 Fed. Reg. 4932).

A "standards completion project" initiated in 1974 by OSHA and NIOSH is extending existing consensus standards. Its purpose is not to consider changes in TLVs, but to supplement existing TLVs with requirements for monitoring, medical surveillance, and reporting of important results and incidents. The standards are being considered in groups of chemically similar substances. Standards proposed to date are listed in Table I-20.

Improving Information. Even with high projections for future numbers of federal and state health enforcement officers, the average workplace in the country could be inspected no more than once every few decades. An occupational health strategy, therefore, must be based not only upon enforcement by government inspectors, but also voluntary cooperation on the parts of individuals and institutions.

The first step toward encouraging voluntary actions is to provide information to all concerned—to workers, their representatives, and management personnel. Complete health standards under Section 6(b) generally contain requirements to make medical examinations available to workers exposed to the regulated substances. All standards, with the exception of those covering the 14 carcinogens, also require employers to monitor the workplace, to maintain records of measurements of regulated substances, and to report any standards violations to their employees.

It is difficult or impossible for workers to identify many hazardous materials used on the job because the labels provide little more than trade names, or have coded identities. A system to notify workers of the presence, nature, and appropriate protection against hazardous materials with which they work would help to prevent a repetition of the Kepone disaster.

Both NIOSH and an OSHA advisory committee considered such a system in separate documents.[106] Each committee called for labels and placards to identify hazardous substances in the workplace and readily available safety data sheets summarizing chemical, physical, and medical information on the substances. However, there were some differences.

The OSHA committee does not address substances that are a hazard by reason of chronic toxicity except to suggest that such substances be handled individually as "special hazards." The NIOSH approach would integrate labeling of chronic effects into the regular hazard reporting system.

TABLE I-20. Standards completion project: standards proposed

Substances	Date
6 Ketones	May 8, 1975 (40 Fed. Reg. 20201)
2-Butanone	
2-Pentanone	
Cyclohexanone	
Hexone	
2-Heptanone	
3-Heptanone	
Alkyl benzenes	Oct. 8, 1975 (40 Fed. Reg. 47261)
p-Tert-butyl toluene	
Cumene	
Ethyl benzene	
Alpha methyl styrene	
Styrene	
Vinyl toluene	
Cyclohexane	
Ketones	
Camphor	
Mesityl oxide	
5-Methyl-3-heptanone	
Ozone	

The committee recommends that labeling use trade names, primarily to protect trade secrets and proprietary information. NIOSH, however, and four labor representatives who dissented from the OSHA report argue that only the inclusion of generic chemical names will provide the worker with positive identification of the chemicals to which he or she is exposed.

Toxic Substances Legislation

The events of the past year again emphasize the problems in dealing with hazardous substances. Not only are many of the problems unanticipated because of a lack of research into the effects of chemicals, such as chloroform, but also because access to and coordination of existing information are lacking, as in the case of Kepone. Sometimes no way exists for the government to limit chemical production or use.

Legislation to remedy some of these shortcomings is pending before Congress, as it has been since President Nixon first proposed it in 1971. This legislation would provide for the comprehensive authority to:

- Control the production, distribution, or use of any chemical substance.
- Provide access to information for assessment of potential problems.
- Require selective testing of new chemical compounds or new uses.

Such legislation would provide the tools necessary to assess, control, and prevent hazardous pollutant problems, rather than to react to them after the fact. One version was passed overwhelmingly (60 to 13) by the Senate in March, but was still pending before the House as of July 1976.

NOISE

Supersonic Transports (SST)

After a year of consideration, including public hearings chaired by William Coleman, Secretary of the U.S. Department of Transportation, the Concorde SST was granted conditional and limited approval for commercial flights into the United States. On February 4, 1976, Secretary Coleman authorized the French-British transport plane, the Concorde, to land four times a day at John F. Kennedy International Airport in New York and twice a day at Dulles International Airport outside Washington, D.C., for a 16-month trial period. No more than the requested number of flights and no flights beyond the 16-month period will be permitted without an in-depth review of the whole issue.[107]

The February 4 decision involved many environmental, technological, international, and safety considerations. Noise was the primary objection to Concorde operations, although safety and stratospheric effects were also important factors. The Concorde's noise levels exceed the noise standards for new supersonic aircraft established in 1969 by the Federal Aviation Administration (FAA). Because of the greater low-frequency content of the Concorde's noise, ground-level structural vibrations are more pervasive than those induced by conventional subsonic aircraft.

Although the Secretary's decision authorized commercial operation of the Concorde into the United States, the final decision may ultimately be reached in the courts. The state of New York has enacted aircraft noise legislation that would ban the Concorde from John F. Kennedy International Airport if identical legislation is enacted by New Jersey. The Port of New York Authority has independently refused entry to John F. Kennedy International Airport for at least 6 months; that decision is being challenged in court by British Airways and Air France.[108]

Fairfax County, Virginia, sought without success to reverse Secretary Coleman's decision by suing in the U.S. District Court for the District of Columbia and by passing a strict noise ordinance that would exclude Concordes.[109] Legislation that would ban or postpone all flights was introduced in Congress, but was defeated.[110] The Environmental Defense Fund asked the U.S. Court of Appeals for the District of Columbia to review Secretary Coleman's decision. The court of appeals found Secretary Coleman's decision appropriate.[111]

EPA submitted a proposal for SST noise standards to FAA in January 1976. This proposal requires all aircraft with no flight time before December 13, 1974, to meet levels applicable to subsonic aircraft and would effectively ban the operation of all but a few Concordes in the United States.[112] The FAA held hearings on the proposal in April 1976.

EPA Actions

EPA published final rules to control noise from new portable air compressors, medium and heavy trucks, and railroad engines and cars. The railroad standard also includes levels that cannot be exceeded by engines and cars already in use.[113]

EPA proposed to FAA a rule dealing with abatement at the nation's airports. This rule requires the establishment of a new system of airport noise abatement planning, with FAA approval of the plans as a condition of continued airport certification. Airport plans are already being developed independently by some airport proprietors because of the pressure of lawsuits seeking compensation for the lowered property values caused by aircraft flyovers. The EPA rule would require the use of a common method and the extension of the planning process to all of the nation's airports that handle commercial traffic.[114]

Noise in the Workplace

The amount of noise workers can tolerate, protection methods, and protection costs were issues in the hearings on proposed OSHA noise standards, which began in June 1975.

OSHA proposed a new noise standard in 1974 to replace the existing standard, adopted in 1971 under authority that predated the Noise Control Act. The new proposal would follow the old standard [115] in limiting exposure to 90 decibels (dB) over an 8-hour day, with the time cut in half for each 5 dB above 90 dB.[116]

NIOSH and EPA proposed an 85-dB level. Economic and technical difficulties involved in achieving this level, however, prompted OSHA to propose retaining the 90-dB level, with the addition of requirements for audiometric testing, monitoring, recordkeeping, and employee notification. A level of 90 dB is equivalent to the noise of a heavy truck at full acceleration from about 50 feet; a level of 85 dB is equivalent to the noise from a pneumatic drill at the same distance. This relatively small difference is believed to have marked effects on hearing loss over years of occupational exposure.

The OSHA proposal met with criticism from all sides. EPA, directed by the Noise Control Act of 1972 to coordinate all federal noise control programs, objected that the permitted noise level is too high, and that OSHA's draft environmental impact statement underestimates ill effects of noise on workers and overestimates costs of abatement.[117] More than 1,000 statements were presented by federal agencies, universities, labor, and industry in hearing and post-hearing comments.

Besides the decibel level, the method and timetable for compliance are at issue. Labor favors engineering and administrative controls as proposed by OSHA. Industry, in general, objects that such controls are neither technically nor economically feasible. It maintains that personal protective devices, such as earplugs, in conjunction with a hearing conservation program to identify and protect workers most susceptible to damage, would be effective and less expensive.

Additional economic studies completed by a contractor for OSHA in December 1975 concluded that the cost of an 85-dB standard would exceed the cost of a 90-dB standard by $8 billion over a 5-year compliance period. The studies assumed that compliance with a 90-dB standard had already been achieved, since it has been law for years.[118] Studies conducted by the Massachusetts Institute of Technology's Center for Policy Alternatives concluded that though costly in the short term, 40 years of compliance with an 85-dB standard would result in net *benefits* of $12.8 billion, or $24.2 billion with a 90-dB standard, in reduced absenteeism and lower workers' compensation alone.[119]

SOLID WASTE

Resource Recovery

Many states and localities have actively investigated waste disposal systems that serve a second purpose—the recovery of energy and other valuable resources. Scarcity of landfill sites, high costs of disposal, and rising energy and materials prices encourage the adoption of resource recovery technologies.

Approximately 70 to 80 percent of residential and commercial solid waste is combustible, and has, on the average, an energy content of about 9 million British thermal units (Btu) per ton. Table I-21 shows that if all of the solid waste in the United States had been converted to energy in 1973, the Btu's generated per year would equal more than 206 million barrels of oil per year.[120] Growth in population and per capita waste generation would cause this figure to increase considerably by 1980. It is highly unlikely that the theoretical maximum will ever be recovered, since most energy recovery systems require large quantities of waste delivered for processing at a single site to achieve economies of scale, and thus appear feasible only for more densely populated areas.

Currently, about 25 communities have resource recovery facilities in operation, under construction, or out for bid. At least another 25 have design or feasibility studies underway. A summary of resource recovery systems, either planned or operating in the United States, is given in Table I-22.[121]

TABLE I-21. Energy potentially recoverable from residential and commercial solid waste (Source: U.S. Environmental Protection Agency)[120]

Recovery	1973			1980		
	Btu [a] (trillion)	B/DOE [b] (thousand)	B/YOE [c] (million)	Btu [a] (trillion)	B/DOE [b] (thousand)	B/YOE [c] (million)
Theoretical	1,194	564	206	1,440	680	248
Available [d]	899	424	154	1,085	512	187
Projected	—	—	—	85	40	15

[a] Btu: British thermal unit.

[b] B/DOE: Barrels per day of oil equivalent (assuming 5.8 million Btu per barrel of oil and 365 days per year).

[c] B/YOE: Barrels per year of oil equivalent.

[d] Based on all Standard Metropolitan Statistical Areas.

Note: These estimates are a function of population, average amount of residential and commercial solid waste generated per person, and energy content of the waste (4,500 Btu per pound). The heating value of 4,500 Btu per pound (9 million Btu per ton) is generally accepted for "as received" unprocessed waste as delivered by a collection truck to a processing or disposal facility.

Different waste processing methods have different recovery efficiencies. For example, a shredding/air classification waste processing system loses some potential energy by removing heavy combustibles from the fuel fraction, while high-temperature incineration with no prior classification would lose far less potential energy. However, no adjustment was made to allow for such processing losses or energy conversion efficiencies (of, say, steam or electricity) because no prejudgment can be made as to which energy recovery method would be used in any given situation.

Technical problems have hampered some systems already in operation. A solid waste/steam generation system in Nashville, Tennessee, intended to provide district heating and cooling downtown, has frequently resorted to fossil fuels because of inadequate emissions control and deterioration of boiler tubes from corrosives in the solid waste fuel. At the federally sponsored Baltimore-Monsanto pyrolosis demonstration plant, emissions controls have failed to meet Maryland's strict particulate standards. That plant also has encountered technical problems and cost overruns in scaling up from a small prototype. Design changes are underway at both the Nashville and Baltimore plants to resolve the problems that have occurred. Connecticut's ambitious statewide resource recovery system, after a temporary slowdown for contract renegotiation, is proceeding apace with the signing of the first contract for a resource recovery system for the Greater Bridgeport area.

Because many of the technologies are being tried for the first time on a commercial scale, technical problems, cost overruns, and institutional difficulties are to be expected, and are not uncommon. The resource recovery demonstration projects funded by EPA are serving as a testing ground, identifying the problems that must be solved for emerging resource recovery technologies, as indicated in Table I-23.

As resource recovery systems become commercially operational, the problems have been receiving attention and are being resolved. Early experience in St. Louis, for example, has shown the exact nature of technical problems involved in direct firing of solid waste with coal. Benefiting from experimentation, St. Louis is now planning a 6,000- to 8,000-ton-per-day plant, which will burn solid waste directly with coal in a modified utility boiler.

The solution of institutional problems is equally important for the success of these systems and for their wider adoption. Projects initiated locally during the past year have found some workable answers to needs for reliable waste supply, regular markets for recovered materials, capital financing, and guaranteed operating revenues.

The Boston North Shore system at Saugus, Massachusetts, which started up in November 1975, is an example. This 1,200-ton-per-day, waste-burning, steam-generating system combines public and private efforts. A private company built and operates the plant; ten municipalities are under contract to provide a regular flow of solid waste; and a large industrial user, the General Electric Company Lynn River Works, has contracted to buy the steam.

The Saugus project stemmed from local initiative, and worked without federal grants, although tax exempt pollution control bonds recently made available to resource recovery systems provided indirect federal assistance (see the Economics section of this chapter for a discussion of pollution control bonds). In many places, as industry sees the potential profits in resource recovery and cities recognize the benefits of an alternative waste disposal method, the two are

TABLE I-22. Resource recovery systems: A status report (as of June 1976)

Location	Process	Output	Announced daily tonnage, tons per day	Announced capital costs (millions)	Status
Akron, Ohio	Shredding, air classification, magnetic separation, burning refuse derived fuel (RDF) in semi-suspension stoker grate boiler	Steam for urban heating and cooling and industrial use; magnetic metals	1,000	25.4	Bids received in September 1975. Delayed because of financing problems
Albany, N.Y.	Fuel preparation, waterwall	Steam	1,200	Unknown	Expected operating year 1980
Ames, Iowa	Baling, shredding, magnetic separation, air classification, screening, other mechanical separation	Baled paper, RDF for use in utility boiler, magnetic metals, aluminum, nonferrous metals	400	5.6	Began operation in fall 1975
Baltimore, Md.^{a}	Landgard^{R} process; shredding, pyrolysis, water quenching, magnetic separation	Steam, magnetic metals, glassy aggregate	1,000	Original estimate 16, revised 26	In shakedown stage. Originally scheduled for January 1976. Revised schedule calls for resolution of mechanical problems by December 1976, air emission problems by 1977
Baltimore County, Md.	Shredding, air classification, magnetic separation	RDF, magnetic metals	600 to 1500	8.4	Shredding, magnetic separation, land filling operational
Berlin, Conn.	Not yet determined	Energy and materials	1,800 to 2,200	Unknown	Request for Proposals (RFP) is out
Beverly, Mass.	Not yet determined	RDF or steam for use in industry and utility boilers	500 to 700	15 to 25	Project delayed because of insufficient waste supply
Braintree, Mass.	Waterwall incineration	Steam	240	Unknown	Began operation in 1975
Bridgeport, Conn.	Shredding, magnetic separation, air classification, drying, froth flotation	EcoFuel II^{R} (powdered RDF) for use in utility boiler, magnetic metals, nonferrous metals, glass	1,800 to 2,200	52	Contracts signed. Scheduled to begin operation in early 1978

Brockton, Mass.	Shredding, drying, air classification, magnetic separation, other mechanical separation	Magnetic metals, Eco-Fuel II® (powdered fuel), for use in industrial boiler	400 to 500	10 to 12	Plant opened October 1973. Expanded 400-TPD plant under construction to be completed in 1977
Chicago, Ill.	Shredding, air classification, magnetic separation	RDF for use in utility boilers, magnetic metals	1,000	19	Under construction. Shakedown operations to begin late 1976
Cuyahoga County, Ohio	Waterwall incineration, magnetic separation	Steam for industrial use, magnetic metals	1,200	33 (approx)	RFP to be issued in spring 1976
State of Delaware [a]	Shredding, air classification, magnetic and other mechanical separation, pyrolysis, anaerobic digestion	Magnetic metals, nonferrous metals, glass, RDF, agricultural/horticultural products	300 municipal solid waste; 230 sewage sludge	25 (approx)	RFP issued Dec. 15, 1975, 3 to 4 years late
Franklin, Ohio [a]	Hydrasposal™ Fibreclaim™ proprietary processes using wet pulping and magnetic separation, sewage sludge treatment	Paper fibers, magnetic metals	50	3.4	Production plant operating since 1971
	Heavy media, jigging, electrostatic precipitation, optical sorting	Aluminum, color-sorted glass	4-TPD input capacity of glass/ aluminum concentrate	See above	Glass/aluminum pilot plant started up in 1973
Hackensack-Meadowlands, N.J.	Fuel preparation	RDF	2,500	Unknown	Expected operating year 1978
Hempstead, N.Y.	Hydrasposal™ (wet pulping), magnetic and mechanical separation, burning of RDF in stoker boiler	Color-sorted glass, aluminum, magnetic metals, electricity	2,000	73	Construction started. Expected operating year 1978
Knoxville, Tenn.	Not yet determined	Energy for use in utility boiler, magnetic metals, aluminum	3,000	Unknown	TVA is considering two systems. Determination to proceed has not been made
Lane Co., Ore.	Not yet determined	RDF for supplemental boiler fuel, magnetic metals	500 to 750	Unknown	RFP issued in March 1976

TABLE I-22—Continued

Location	Process	Output	Announced daily tonnage, tons per day	Announced capital costs (millions)	Status
Lexington, Ky.	Waterwall incineration	Steam	700	Unknown	Expected operating year 1978
Madison, Wis.	Fuel preparation, materials recovery	RDF for supplemental burning	200	Unknown	Expected operating year 1979
Milwaukee, Wis.	Shredding, air classification, magnetic and other mechanical separation	Bundled paper and corrugated, magnetic metals, aluminum, RDF for use in utility boiler	1,200 to 1,600	20	Construction underway. Expected operating year late 1976
Minneapolis/St. Paul, Minn.	Waterwall incineration	Steam	1,200	50	Plan indefinite
Monroe County, N.Y. (Rochester)	Shredding, air classification, magnetic and other mechanical separation, froth flotation	RDF for use in utility boiler, magnetic metals, nonferrous metals, mixed glass	2,000	30	Bids issued for construction in May 1976
Montgomery Cty, Md.	Fuel preparation	RDF for supplemental burning	1,200	Unknown	Feasibility study completed. Expected operating year 1979
Montgomery Cty, (Dayton), Ohio	Fuel preparation	RDF for supplemental burning	1,600	Unknown	Expected operating year 1979
Mt. Vernon, N.Y.	Pyrolysis	RDF for supplemental burning	400	Unknown	Expected operating year 1978
Nashville, Tenn.	Waterwall incineration	Steam for urban heating and cooling	720	24 to 26	Operational. Testing air pollution control devices. Will operate full scale after devices are installed
New Orleans, La.	Hand-picked paper, shredding, air classification, magnetic and other mechanical separation	Paper, magnetic metals, aluminum, other nonferrous metals, glass	650	6	Under construction. Shredding startup slated for July 20, 1976; full recovery operation to begin 1977

New York, N.Y.	Fuel preparation	RDF for supplemental burning	1,500	Unknown	Expected operating year 1980
Palmer Township, Pa. [a]	Shredding, air classification, magnetic and other mechanical separation	Magnetic and nonmagnetic metals, densified RDF	160	3.5	Grant received from state, Construction expected to begin spring 1977
Pompano Beach, Fla.	Shredding, air classification, magnetic separation, anaerobic digestion of air classified light fraction with sewage sludge	Methane, magnetic metals	50 to 100	3	Demonstration plant under design, construction to begin in 1976, startup expected in 1977
St. Louis, Mo. [a]	Shredding, air classification, magnetic separation, "nuggetizing"	RDF for utility boiler, magnetic metals, mixed nonmagnetic metals	325	3.9	On line, 6,000- to 8,000-ton/day plant utilizing same technology in planning and procurement stage
San Diego County, Calif. [a]	Shredding, air classification, magnetic and other mechanical separation, froth flotation, pyrolysis	Pyrolytic oil, magnetic and nonferrous metals, glass	200	14.5	Construction underway. Expected startup January 1977
Saugus, Mass.	Waterwall incineration, magnetic separation	Steam for industrial use, magnetic metals	1,200 (two boilers with 600-TPD capacity each)	35	In operation
Scranton, Pa.	Shredding, air classification, drying, magnetic separation, aluminum separation	RDF for producing steam, magnetic metals, aluminum	600	16 (approx)	Contract expected 1976
Seattle, Wash.	Pyrolysis	Ammonia	1,500	90 to 100	RFP issued. Expected operating year 1980
South Charleston, W. Va.	Purox™ oxygen converter (pyrolysis), shredding	Fuel gas	200	Unknown	Operating demonstration plant
Toledo, Ohio	Shredding, air classification	RDF, magnetic metals	1,000	Unknown	Under design

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[a] Funded by U.S. Environmental Protection Agency.

TABLE I-23. Problems identified in EPA-sponsored resource recovery demonstration projects

Location	Problems identified
San Diego, Calif.	Site location: cost increases resulting from inflation, redesign, technical refinements
State of Delaware	Institutional problems: change in original technology, site selection, waste supply, marketing of output, politics
Baltimore, Md.	Scaleup problems; mechanical and air emissions problems
St. Louis, Mo.	Processing problems: shredder maintenance high, dust control, air classification, wear; burning problems: air emissions, high ash residue
Franklin, Ohio	Insufficient refuse supply to operate full capacity; limited markets for output

working together to implement resource recovery systems and are not waiting for federal assistance. The Minneapolis/St. Paul area is contemplating an arrangement similar to the Saugus project. Milwaukee is working with American Can's Americology Division to build a resource recovery plant. Several state authorities are reviewing bids for regional resource recovery facilities.

Complex technologies with high capital costs, however, will never be feasible for many communities. Recognizing this, EPA has assisted Somerville and Marblehead, Massachusetts, in securing markets and setting up systems for separate collection of paper, metal, glass, and mixed wastes. Public response and participation in the program has been high.

Congressional Initiatives

Both Houses of Congress have considered major legislation on solid waste management during the past year. Discussions of solid waste initiatives have included some much discussed proposals, such as comprehensive planning at regional, state, and local levels, as well as a product charge system that would impose an excise tax on consumer packaging and paper, based on their costs of disposal. The concept is one of full-cost pricing in which the prices reflect disposal costs of products, as well as the manufacturers' cost of producing them. Theoretically, the charge will discourage wasteful consumption and encourage the use of recycled materials.[122]

EPA Guidelines

Following a suit by the Natural Resources Defense Council,[123] EPA has begun to issue guidelines for federal agencies under the Solid Waste Disposal Act of 1965 (P.L. 89-272) and Amendments of 1970 (P.L. 91-512). Final guidelines have been issued for procurement, storage and collection, and source separation. Resource recovery guidelines are scheduled for final promulgation on September 8, 1976, and the controversial beverage container guidelines on September 17, 1976.

Issued in draft form in November 1975, the beverage container guidelines require a 5-cent deposit on all beer and soft drink containers sold at federal installations. The issues at stake go beyond controlling litter; they include conservation of raw materials and energy and reduction in the costs of solid waste collection and disposal. The most hotly contested issue is the economic impact on employment, prices, and the beer and soft drink industry. The guidelines will be compulsory for federal facilities and will provide further information about the costs and benefits of mandatory deposits.

Secondary Materials Market

Use of recycled metals, paper, textiles, and other materials declined in 1975. Waste paper reuse dropped 26 percent, to the lowest level in a decade. Copper scrap consumption was down 30 percent, zinc 27 percent, stainless steel 43 percent. Reuse of aluminum scrap was down 6.6 percent despite a promotional campaign for aluminum can recycling, which succeeded in doubling the poundage turned in. The recession seemed to be the principal cause of the decline. Virgin material producers also experienced declines, but less so. As is typical, the fluctuations were greater in the secondary materials market.

Prices for selected secondary materials seemed to be recovering toward the end of 1975 and in the first quarter of 1976, as indicated in Table I-24. Wastepaper demand is traditionally an economic barometer for all recycled materials; current signs of recovery in that

TABLE I-24. Midrange prices of selected secondary materials (Source: National Center for Resource Recovery)

Date	Paper [a]		Ferrous [b]		Aluminum [c]
	No. 1 news	Corrugated containers	No. 1	No. 2	Old sheets and cast
June 1972	20	22	34.50	27.50	5½
December 1972	20	24	41.50	29.50	5½
June 1973	18	33	51.50	40.50	8½
December 1973	50	55.50	85.50	46.50	10
June 1974	35	45	99.50	49.50	14½
December 1974	21.50	25	79.50	44.50	7½
June 1975	21.50	17.50	69.50	42.50	7¼
December 1975	35.00	20.00	62.50	41.50	9¾
March 1976	35.00	20.00	84.50	59.50	10¾

[a] Paper: board mill market prices, f.o.b. trucks or cars at dealers' or producers' plants, dollars per ton. Source: *Official Board Markets* (Chicago prices).

[b] Ferrous: No. 1 is "heavy melting scrap," No. 2 is "dealer bundles." Prices obtained in trade based on representative tonnages delivered to consumer, dollars per gross ton. Source: *Iron Age* (Chicago prices).

[c] Aluminum: Dealers' buying prices, f.o.b. New York, cents per pound. Source: *Iron Age*. A user price series is not available for aluminum.

market may be a forerunner of improved conditions in all sectors of the recycling industry. Prices for most sectors of the bulk wastepaper market started to move upward in October, paralleling the general upward trend in the economy. Construction, packaging, and advertising industries, all highly responsive to consumer demand, are the principal users of bulk wastepaper. The growing demand for wastepaper overseas is another reason for improvement in the wastepaper markets. This increased demand made 1975 the second highest year for wastepaper exports in U.S. history.[124]

Ferrous scrap metal prices dropped in 1975, probably in response to lower production of steel products and also to the stockpiled inventory accumulated in 1974. The upswing in first quarter 1976 prices for ferrous scrap and aluminum reflect generally improved market conditions.

A noteworthy development in the secondary materials market was the October 1975 opening of the St. Louis Industrial Waste Exchange, established by the St. Louis Regional and Growth Association and modeled after the European waste exchanges. This new exchange will serve as a clearinghouse for information on availability and demand for waste or residual materials that have no other established market.

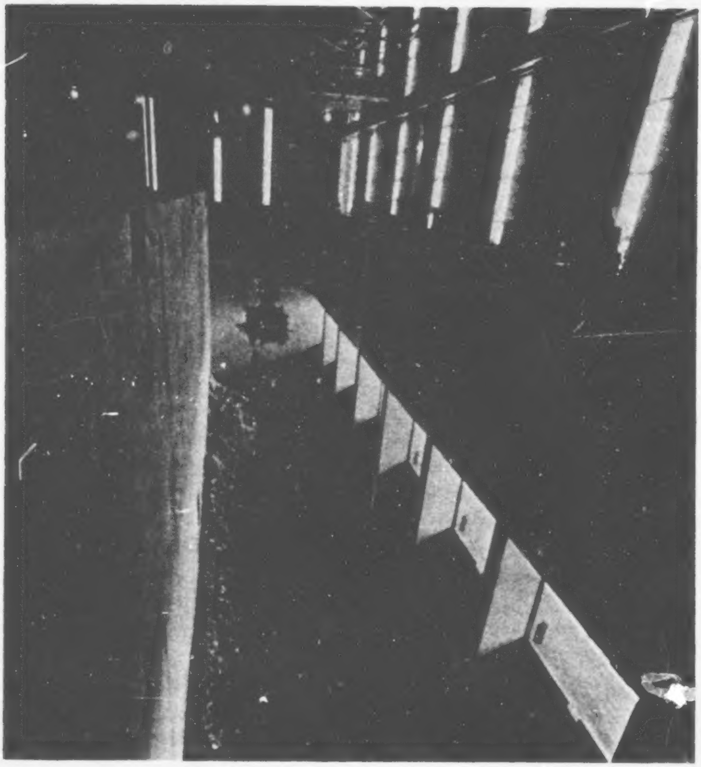
Plastic Bottles

The U.S. District Court for the District of Columbia in March 1976 ruled that FDA must consider environmental factors (including solid waste disposal) in its decisionmaking process even though these considerations are not expressly identified in FDA's statutes. The suit by the Environmental Defense Fund [125] resulted from an FDA determination that, despite the environmentally undesirable aspects involved in an approval of acrylonitrile plastic beverage containers, the approval could not be denied because such bottles were safe (as defined by FDA's statutes).

Introduction of the bottles would tend to increase the use of throwaway beverage containers, and consequently increase litter. The bottles also could produce harmful gases and possibly contaminate ground water when disposed of in municipal incinerators and open dumps.

Sludge

In response to the growing concern over the problems of sludge disposal, EPA's Office of Solid Waste Management was recently designated as the lead office in coordinating all matters relating to disposal of solid residuals, including environmentally sound methods of sludge disposal and beneficial methods of use.



This giant storage pit is the first stop for refuse collected for conversion to energy at a new resource recovery plant in Saugus, Massachusetts (Photo credit: Wheelabrator-Frye, Inc.)

DRINKING WATER

Standards for safe drinking water are undergoing considerable change as a result of new knowledge. The discovery of asbestos fibers in the water supply of Duluth, Minnesota, and of 66 organic chemicals, some of which are also carcinogens, in New Orleans drinking water spurred the quick passage of the Safe Drinking Water Act in December 1974.[126]

Subsequent studies have shown that toxic chemicals discharged by point sources into water supplies are only a part of the problem; some potential toxicants, such as chloroform, are formed when raw water containing organics is disinfected with chlorine.[127] EPA is examining methods of controlling the level of harmful organics without compromising disinfection goals.

In March 1975, EPA proposed National Interim Primary Drinking Water Regulations,[128] largely based on the traditional concept of water purity as freedom from microbiological contamination—specifically, the 1962 Public Health Service drinking water standards. They also included, however, a maximum permissible level for certain inorganics, for a general indicator of the newly discovered chlorinated organics, and for certain chlorinated hydrocarbon pesticides, including heptachlor/chlordane, which were then under consideration for registration cancellation. Aldrin, dieldrin, and DDT, now banned for most uses, were omitted from the list pending analysis of the results of a nationwide survey of water systems recently conducted by EPA.

After review of more than 3,000 statements of oral testimony and written comments, EPA promulgated standards on December 24, 1975,[129] to take effect in June 1977. The standard for the measurement of total organics was dropped, because of a dearth of information on health effects and because techniques presently available for detecting and removing organics from water are considered inadequate. EPA is investigating other methods for determining total organic contaminant levels. Heptachlor, heptachlor epoxide, and chlordane were dropped from the list pending the results of the pesticide cancellation and suspension hearings. EPA is, however, adopting regulations on organic chemical monitoring, and, as soon as it has enough information in hand, the agency expects to amend the interim regulations to handle the organic chemicals problem.

The Safe Drinking Water Act requires the proposal of revised primary drinking water standards within 10 days after the National Academy of Sciences presents its report on recommended health-based maximum contaminant levels. The report, due before December 16, 1976, will present analyses of the health effects of significant particulate contaminants. Where possible, NAS will specify recommended maximum levels. After considering these recommendations, EPA will then propose *recommended* levels for substances that may have an adverse effect on public health. EPA will also propose *enforceable* maximum contaminant levels that will be as close to the recommended levels as economically and technologically feasible.

The Environmental Defense Fund has filed a petition for review of EPA's interim primary standards in the U.S. Court of Appeals for the District of Columbia. The suit charges that the regulations do not protect the public health adequately because they fail to include carcinogens and several other hazardous substances and fail to require procedures that adequately control viruses. The case has not yet been heard by the court.[130]

LAND USE AND COASTAL ZONE MANAGEMENT

Five years have passed since CEQ published *The Quiet Revolution in Land Use Control*. That document reviewed the pioneering efforts of a few states and regions to restructure government and to fashion policies for improving land development decisions. Since that publication, public officials, private citizens, and developers have become more aware of land use issues and their relation to growth, development, and preservation decisions. New laws and new programs have been enacted. Our previous Annual Reports reported on new federal legislation and on local efforts to manage growth, but gave little attention to activities at the state level.[131] This year's Annual Report focuses on the accomplishments of the states, most of which today have an active interest in land use controls—something that was rare a few short years ago.

STATE ACCOMPLISHMENTS

According to a recent study conducted for the Department of Housing and Urban Development (HUD) by the American Institute of Planners, 27 of the 50 states had a total of 38 operating general land use programs by the end of 1975.[132] Twenty-four of the programs established some degree of state authority to coordinate major local land use decisions, nine took the more traditional approach of mandatory local planning, and five created comprehensive state programs involving land use permits to deal directly with developers.

All 30 eligible states were participating in the Federal Coastal Zone Management Program, and five had special laws to protect their shorelines. Twenty-two had wetlands protection laws, 26 regulated development in floodplains, and 13 had legislation to protect defined "critical areas." Forty-two had adopted preferential tax policies to encourage farmers and other owners of open space to retain their holdings. Thirty-four had powerplant siting laws, many of which covered other industrial facilities, and 38 regulated strip mining within their boundaries. A summary of these state land use programs is given in Table I-25.[133] [134]

The states have faced and resolved some common problems in various ways. One recurring issue is at what level of government to locate the land use authority. There has generally been little objection to locating at least some *planning* authority at the state level; a broad view of economic, social, and environmental conditions is necessary to plan well. With *regulatory* authority the case is different. The states obviously have the constitutional authority to regulate land use, but they have traditionally ceded a large portion of that authority to local government.

The American Law Institute adopted a Model Land Development Code last year in final form. This model code [135] has been under development for many years and has served as the basis for proposed federal land use legislation. The code recognizes that some major regulatory decisions involving land use have greater than local impact and that some special geographical areas require state involvement for their protection. For such decisions and concerns, the code urges state reassertion of power, which has been turned over to local authorities.

TABLE I-25. State land use programs [134]

State	Type of program			Coastal zone management[d]	Wetlands management[e]	Power-plant siting[f]	Surface mining[g]	Designation of critical areas[h]	Differential assessment laws[i]	Flood-plain management[j]	Statewide Shorelands Act[k]
	Comprehensive permit system[a]	Coordinated incremental[b]	Mandatory local planning[c]								
Alabama				X		X	A			X	
Alaska		X		X		X			B		
Arizona		X				X			A	X	
Arkansas						X	A, B		A		
California		X		X		X	X		C	X	
Colorado						X	X	X	A	X	
Connecticut		X		X	X	X			B	X	
Delaware		X		X	X				A		X
Florida	X	X	X	X	X	X	A	X	A, C		
Georgia		X		X	X		A, B				
Hawaii	X	X		X		X	X	X	B	X	
Idaho			X				X		A		
Illinois				X		X	A, B		B	X	
Indiana		X		X			A, B		A	X	
Iowa							A, B		A	X	
Kansas							A, B				
Kentucky						X	A, B		B		
Louisiana				X	X						
Maine	X	X	X (LTD)	X	X	X	A	X	B	X	
Maryland		X		X	X	X	A, B	X	B	X	
Massachusetts				X	X	X			B		
Michigan				X			X		C	X	X
Minnesota		X		X	X	X	X	X	B	X	X
Mississippi				X	X					X	
Missouri					X	X	X		A	X	
Montana		X	X			X	A, B	X	B	X	X
Nebraska			X			X			B	X	
Nevada		X	X			X		X	B		
New Hampshire				X	X	X			B, C		
New Jersey				X	X	X			B	X	

New Mexico		X				X	A		A		
New York	X	X		X	X	X	X	X	B	X	
North Carolina		X		X	X		X		B	X	
North Dakota						X	A		A		
Ohio				X		X	A		B		
Oklahoma							X		A	X	
Oregon		X	X	X		X	A	X	B		
Pennsylvania				X	X	X	A	X	B		
Rhode Island		X		X	X	X			B		
South Carolina				X		X	A		B		
South Dakota							A	X	A		
Tennessee						X	A, B				
Texas				X	X		X		B		
Utah		X					A		B		
Vermont	X	X			X	X	X		C	X	
Virginia			X	X	X		A, B		B		
Washington		X		X	X	X	A		B	X	X
West Virginia							A, B			X	
Wisconsin		X		X	X	X	X	X		X	
Wyoming		X	X			X	A		A		

[a] State has authority to require permits for certain types of development.

[b] State-established mechanism to coordinate state land-use-related problems.

[c] State requires local governments to establish a mechanism for land use planning (e.g., zoning, comprehensive plan, planning commission).

[d] State is participating in the federally funded coastal zone management program authorized by the Coastal Zone Management Act of 1972.

[e] State has authority to plan or review local plans and the ability to control land use in the wetlands.

[f] State has authority to determine the siting of powerplants and related facilities.

[g] State has statutory authority to regulate surface mines. (A) State has adopted rules and regulations; (B) State has issued technical guidelines.

[h] State has established rules, or is in the process of establishing rules, regulations, and guidelines for the identification and designation of areas of critical state concern (e.g., environmentally fragile areas, areas of historical significance).

[i] State has adopted a tax measure which is designed to give property tax relief to owners of agricultural or open space lands. (A) Preferential Assessment Program: Assessment of eligible land is based upon a selected formula, which is usually use value. (B) Deferred Taxation: Assessment of eligible land is based upon a selected formula, which is usually use value and provides for a sanction, usually the payment of back taxes, if the land is converted to a non-eligible use. (C) Restrictive Agreements: Eligible land is assessed at its use value; there is a requirement that the owner sign a contract, and a sanction, usually the payment of back taxes if the owner violates the terms of the agreement.

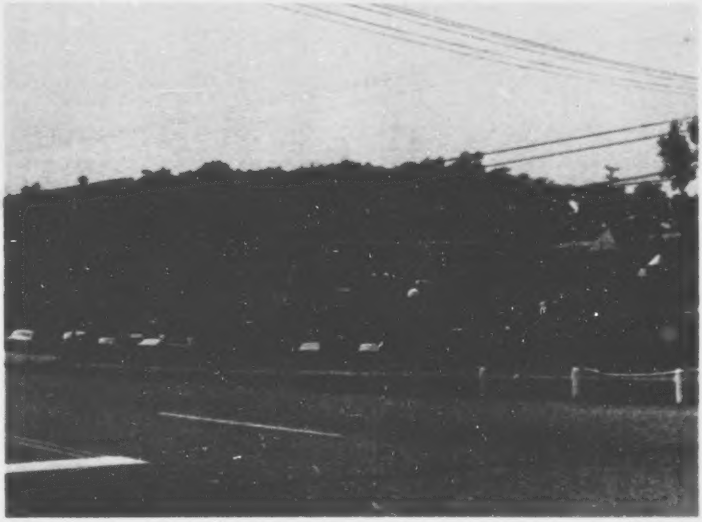
[j] State has legislation authorizing the regulation of floodplains.

[k] State has legislation authorizing the regulation of shorelands of significant bodies of water.

Florida, Hawaii, Maine, New York, and Vermont have the strongest state regulatory authority over land use matters. Hawaii has had statewide zoning since 1960, based on a four-class system of urban, rural, agricultural, and conservation lands. The rationale behind this strong state role was to protect the state's agricultural investment from urban encroachment.[136] The law was amended in 1975 to clarify the powers of the State Land Use Commission.[137] Florida has enacted comprehensive land use legislation to protect designated critical areas, with state review of major developments through regional commissions and other state authorities.[138]

The Adirondack State Park area of New York shows many of the classic conditions that have prompted the reassertion of state authority. The park encompasses several thousand acres of northern New York, but the state holdings are interspersed with extensive private lands within the park boundaries. Seasonal home development was increasing in these inholdings and so was overall development to support the recreational opportunities there.

At the same time, however, the area was experiencing a downward trend in employment. Much of the new development was poorly controlled by local governments hungry for revenues and, because the parklands are scattered among the private lands, the impacts overflow to the public lands. Recognizing that the park is a resource for use by all citizens, the state legislature enacted broad regulatory



This amusement park is on private land adjacent to the New York Adirondack State Park. Because overall development was adversely affecting the state park, the New York state legislature enacted broad regulatory control for the Adirondack Park Authority (Photo credit: Adirondack Park Agency, New York) controls for the park authority.[139] Some developers and local government have continued to oppose the regulation even though in a recent report, the authority concludes that, although much new development has had to meet tougher design and environmental standards, there is little evidence that development has been turned away.[140]

Maine [141] and Vermont [142] have state permit requirements for major residential, commercial, and industrial developments. In the last two sessions, however, the Vermont legislature failed to enact the final stage of its land use law, which would increase state authority over development decisions. The newly elected Governor of Maine withdrew the state's application to the federal government to approve a segment of the coastal zone regulatory authority pending a study of whether or not the local role in the program should be strengthened.[143] The local governments of Maine and Vermont are highly representative and traditionally strong, so that a reassertion of "town-meeting" authority is not surprising.

MANDATORY LOCAL PLANNING

Not all states have assumed major new land use roles. One interesting recent development is the emergence of state laws requiring that counties and localities develop their own land use plans. Such plans have been used for many years in most urban regions, but seldom in some rural areas. Mandatory local planning laws are now on the books in nine states—Florida, Idaho, Maine, Montana, Nebraska, Nevada, Oregon, Virginia, and Wyoming.[144] In late 1975, Massachusetts passed the Growth Policy Development Act of 1975,[145] which provides for bottom-up planning and mandates the formation of a growth policy committee in each community. In all states, the quality and usefulness of the plans produced will depend on the financial support given to their preparation, and on the willingness of local and state officials to use the plans in making development decisions.

PROJECTING GROWTH

Many states have tried to establish long-range growth projections to provide some guidance for local land use planning as well as for state growth strategies and economic development. Some of these efforts have involved thousands of citizens, with extensive hearings and meetings to reach statewide consensus. The effort in the state of Washington has resulted in a set of growth policies which have spurred the enactment of much progressive environmental state legislation now in effect.[146] In Utah, an "alternative futures" approach uses a computer to help identify the long-term implications of proposed policies.[147] Georgia, Kansas, Minnesota, and Washington also have produced guidance documents for growth and future goals.[148]

Several states have established the comprehensive planning and coordination of state activities needed to meet the goals. California has developed comprehensive plans for 1976 in four important areas: the coastal zone, transportation, air, and water. Each plan specifies actions to be taken by state and local bodies and suggests possible new legislation. In South Dakota, policy documents for land use, as well as other areas such as housing, economic development, and rural development, have been adopted by the state legislature; the documents for agriculture and transportation are almost completed. Connecticut, Indiana, Massachusetts, and North Carolina have given expanded jurisdiction to comprehensive planning agencies to review policies.[149]

CAPITAL INVESTMENT PLANNING

Allocation of public money for building infrastructure (sewers and water lines, roads, schools, and so on) primarily determines where growth occurs. Through its extensive matching-grant programs, the federal government exercises considerable influence over where the money is spent and where the facilities are built. The state role is often more crucial, however, in choosing which communities receive the money and for which projects. The state establishes the priority list for grants authorized by the Federal Water Pollution Control Act. State priorities are also important in allocating federal transportation, water resource, and education funds. Communities high on the state eligibility lists receive federal funding, build new facilities, and thus may experience growth and change. Unless planning for capital investment is coordinated with land use strategy, growth may occur around the new infrastructure, regardless of the community's land use plans and intentions.

As states move toward integration of planning processes with agency budgets, the opportunities become apparent for directing growth by means of planned capital investment in infrastructure. To make this step work, developers must be encouraged to build where the facilities will be located. The state of Maryland now requires that all building permits and subdivision plans be consistent with community plans to provide adequate water and sewer facilities.[150] Pennsylvania requires similar compliance with the Sewage Facilities Act.[151] Montana requires developers to report to the county what public facilities will be needed and to propose how their costs should be met.[152] The Governor of Vermont has ordered better coordination of different types of capital investment to reduce costs and to provide for the proper location of growth.[153] The Office of State Planning in Massachusetts is attempting to discourage infrastructure investment and housing development in suburban and urban fringe areas in order to encourage the restoration and stabilization of older central areas.[154] These efforts are a start, but the use of capital investment planning as a land use mechanism has hardly begun to reach its full potential.

TARGETED STATE LAND USE REGULATIONS

Some state controls apply only to specific types of lands or geographical areas. Florida has strong takeover powers with respect to designated critical areas. Soon after its comprehensive land use law was enacted, the state declared that the Monroe County regulatory program in the Florida Keys was inadequate and took over land use regulation there until an adequate county plan and adequate regulations were developed.[155] Maine's shoreline protection law and Oregon's land use law authorize the state to intervene if local regulation proves inadequate.[156] The new law protecting the island of Martha's Vineyard gives similar power to the Massachusetts state agency.[157]

Other states have established processes for identifying and protecting areas of special state concern. This approach clearly defines state involvement in designated areas, and thus may not arouse the degree of opposition from local governments or private parties as do general takeover provisions. Under the Maryland law, the areas subject to state control must be designated by counties,[158] and the Florida law limits critical areas to 5 percent of the state's land area. Colorado, Hawaii, Maine, Minnesota, Montana, Nevada, New York, Oregon, Pennsylvania, South Dakota, and Wisconsin also have laws to protect critical areas.[159]

States are also showing substantial interest in the preservation of farmlands for crop production, scenery, open space, and in some cases as a land use control to prevent sprawl. Forty-two states now have laws that provide for taxing farms and other space at current use value rather than at development value. A recent CEQ study indicates that, while these laws do lower the cost of keeping the land in open space, they provide insufficient incentives, by themselves, to affect materially the pattern or rate of conversion to other uses. Such laws should be applied in conjunction with other land use measures if these effects are desired.[160]

The conveyance tax that Connecticut places on all sales of open land is one of the innovative techniques developed by the states.[161] This tax is set at 10 percent for any resale in the first year after purchase and diminishes to zero over a 10-year period, thus providing a penalty for quick turnover of farms and open space. Colorado has a new water condemnation bill requiring municipalities to prepare a community growth development plan and meet other requirements before they can appropriate water rights. The law seeks to protect water needs for farming.[162]

Montana has adopted a tax system that amplifies the current-use taxation approach to predesignate a series of land use classes and to limit preferential tax treatment to conforming uses in each land area.[163] The state of New York has established an extensive program of voluntary agricultural districts, whereby landowners are given tax and other financial benefits in return for keeping their land in agricultural use.[164] Some 3.9 million acres in 46 counties, representing one-fourth of all the farm land in the state, have already been brought under the 7-year agreements.[165]

Floodplains and wetlands regulations are two other areas where states have become increasingly active. The National Flood Insurance Program (NFIP) has brought thousands of communities with flood hazard areas into a program whereby new structures must either be kept out of floodplains or adequately floodproofed, while existing structures are given subsidized flood insurance rates.[166] Unfortunately, there are many rural areas not covered by the program.

The focus of the NFIP is on human safety and property protection, with the local community developing its own floodplains management program. But the program still allows development of the floodplains with consequent loss of wildlife habitat and the floodplains' natural flood storage function. Therefore, there is still a need for state regulation, and states such as Arkansas and Indiana have especially active state permit programs that encourage more compatible use such as agriculture and open space.[167] [132]

Regulation of wetlands under state law is common, but is structured differently in different states. Virginia and Maine continue to rely on local permission and enforcement of state protective regulations. Other Atlantic coastal states, including Connecticut, Georgia, Maryland, Massachusetts, New Jersey, and New York require state permits for activities affecting the wetlands.[168]

There also is a growing federal role in wetlands regulation. The federal courts have interpreted Section 404 of the 1972 amendments to the Federal Water Pollution Control Act as giving authority to the U.S. Army Corps of Engineers to regulate activities on all wetlands included in the definition of U.S. waters. Because the Fish and Wildlife Service reviews federal activities and permits under the Fish and Wildlife Coordination Act,[169] this broadened jurisdiction extends its commenting responsibility over wetlands.

Broader statutes, including development and management of resources in the coastal zone, have also been enacted by several states. Some of this legislation predates enactment of the Coastal Zone Management Act of 1972, which provides federal funds to develop and operate a state-supervised regulatory program in the coastal zone. The act has proven to be popular, with all 30 eligible states participating in the program of matching grants.

The state coastal zone management programs in Delaware, North Carolina, Oregon, Rhode Island, and Washington have attracted the most attention. Some of these programs depend upon a system of state permits to regulate land use changes, although the North Carolina program relies on the 30 coastal counties to conduct the program under the state auspices, and in Washington the permit authority extends to only 200 feet from shorelines. The Delaware program is perhaps the most well known because it prohibits heavy industry in a coastal strip 2 miles wide. Much of this protected coastal zone lies along the heavily traveled Delaware Bay downstream from existing industrial areas.

The coastal zone program in California was mandated by the 1972 Coastal Initiative (Proposition 20). During the 3-year interim period when a plan was being developed, regional coastal zone commissions reviewed and decided on all development proposals for the coastal zone. The detailed plan, which was submitted to the Governor and state legislature for approval in December 1975, calls for a wide range of regulatory actions to promote agriculture, neighborhoods, fishing, parklands, and the continued development of existing parks and marinas. It seeks to balance coastal access with resource protection, economic development with conservation, and urban expansion with preservation of natural areas.[170]

ENERGY AND LAND USE

The state land use issues most discussed in the past year or two arise from plans to develop U.S. energy resources in areas that have no previous experience with energy or often with any kind of industrial development. Several coastal and western states are likely to experience rapid substantial change with the opening of new areas of the OCS for oil and gas development and the expansion of coal leasing programs on federal lands. In many ways, these developments have served as a stimulant to efforts to develop more responsive and more capable planning and regulatory programs.

For the past few years, the states have attempted to deal with important energy issues related to land use. As noted, 34 states have enacted energy facilities siting legislation, many before the 1973 oil embargo which turned so much public attention to energy issues. The first such law was enacted in 1970 in the state of Washington.[171] The law provides for the formation of a panel with authority over energy facilities. The panel's members meet to reach common and timely decisions about energy facility siting. A more centralized state authority was enacted in Maryland;[172] this law has become the model for many other states. In addition to its planning and siting approval provisions, the Maryland law provides for an energy tax to finance necessary impact studies, and authorizes the state agency to purchase a "bank" of alternative sites for future uses.

The announced intention of the federal government to explore for oil and gas in new areas of the OCS has spurred coastal states to adopt planning measures related to possible on-shore development of harbor supply bases, platform construction yards, refineries, tank farms, petrochemical facilities, and related industrial, commercial, and residential development. Some states have initiated specific regional impact studies; New Jersey, for example, is examining the effects that OCS development could have on presently rural Cape May and Cumberland counties.[173]

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The U.S. Congress enacted amendments to the Coastal Zone Management Act relating to onshore impacts of OCS development.[174] Included in the amendments are federal funds to assist with planning and to offset the cost of infrastructure and service investments required by impacted communities. The amendments include a loan fund of more than $1 billion for OCS-related impact assistance. Grants would be provided for planning necessary public facilities. Loans would pay for front-end costs of facilities, with provisions for communities to repay the loans once they begin to collect taxes from new facilities and new residents. "Forgiveness" provisions would prevent burdening communities with repayment when the energy resources are not developed to the extent anticipated or if tax revenues fail to cover the cost of the infrastructure.

The states most likely to be impacted by increased development of western coal and other energy resources have begun to play an active role in advanced planning. Montana, Utah, and Wyoming are especially concerned about the "boom and bust" phenomenon on coal lands and how to mitigate its impacts. Wyoming's new land use law gives the state the capacity to plan and direct financial resources into impact areas.[175] The effort to adopt regulatory authority for statewide land use in Utah was set back when the law enacted by the legislature was defeated in a referendum.[176] Thus, the state will have no broad authority to deal with the major impacts on the land and on existing communities which are likely to result from planned powerplants and energy resource development.

The connection between energy development and growth management has been clearly recognized in Montana. The responsibility for developing an energy policy and alternative growth goals has been placed with the state's Energy Advisory Council and with the Lieutenant Governor.[177] The Montana legislature has also expanded the coverage of the 1973 Utility Siting Act and enacted strict controls over the transfer of agricultural water rights to any other use.

The efforts of other western states likely to be affected by energy development have been discussed elsewhere in this section. Colorado has enacted a statewide land use law, and South Dakota has completed many important parts of its state plan for future development. Idaho has not taken action on a statewide basis as yet, although mandatory local planning was recently enacted.[178]

NATURAL RESOURCES

WATER

Water Resources Development Act, Section 80 Study

Water resource development and pollution control programs are distributed among 16 federal agencies and more than 180 budget accounts. When considered together, these diffuse programs constitute a substantial portion of the federal budget (5 percent in fiscal year 1976) and are expanding. Federal funds made available for these programs throughout the United States totaled $7.4 billion in FY 1974, $9.1 billion in FY 1975, and $10.2 billion in FY 1976.

These are among the findings of a 1-year study of federal water resources planning and cost sharing policy completed in September 1975 by the Water Resources Council (WRC).[179] The study was requested by Congress in Section 80(c) of the 1974 Water Resources Development Act, and was assigned to WRC by the President.

The eight-part study included a comprehensive review and prospectus of federal funding patterns in water resources development, and examined several controversial policy issues relevant to environmental concerns. Key issues under consideration include:

- *Objectives.* Whether to retain the currently accepted dual planning objectives of environmental quality and national economic development, or to allow projects to be designed for other purposes as well, such as regional development or social well-being. Any such changes would require amendments to the Principles and Standards for Planning Water and Related Land Resources adopted by the WRC in 1973.
- *Discount Rate.* Whether to maintain, raise, or lower the current discount rate applied in benefit/cost analysis to projected future benefits. Because most costs are incurred before benefits are received, future dollar benefits are usually discounted; a higher discount rate reduces the present dollar value of future benefits and makes large capital-intensive projects more difficult to justify.
- *Cost Sharing.* How to achieve consistency among federal agencies in the level of non-federal cost sharing required for similar project functions. Present inconsistencies encourage "shopping" by state and local authorities for the most favorable terms. In this regard, consideration has been given to increasing non-federal contributions to certain types of federal water resource development projects, particularly those involving flood damage reduction, navigation, and water supply for agricultural production. The Section 80 study found a wide range of cost sharing requirements for different purposes; these findings are summarized in Table I-26.[180]

Presidential recommendations on these issues are expected to have long-term effects on the economic and environmental impacts of federal water resource development projects.

Wetlands

Controversy over the scope of the regulatory authority of the U.S. Army Corps of Engineers under Section 404 of the 1972 amendments to the Federal Water Pollution Control Act subsided after publication

TABLE I-26. Non-federal cost sharing for water resources programs and projects by 12 major purposes [177]

Major purpose	Composite non-federal cost share, %	Implementation non-federal cost share, %	OM&R non-federal cost share,* %
Hydro power generation	64	64	56
Area redevelopment benefits	60	39	98
Water quality management	60	31	98
Water quantity management	54	51	72
Other	25	16	66
Unallocated	23	35	9
Urban flood damage reduction	20	17	40
Recreation	19	16	34
Agricultural production and rural flood damage reduction	16	11	48
Aquacultural production	8	7	11
Navigation	7	7	8
Natural areas and cultural resources	6	0	56
National average	30	24	58

*OM&R = operations, maintenance and replacement, reported and analyzed as given by the agencies for all single purpose programs and projects. However, for multiple purpose projects, OM&R costs were distributed to purposes in accordance with the allocated costs for implementation, as agencies do not allocate OM&R to purposes.

by the Corps of revised interim regulations in July 1975. Section 404 assigns to the Corps primary authority to regulate by permit the deposition of dredged or fill material into waters of the United States. The controversy arose after a court decision,[181] discussed in last year's Annual Report, that directed the Corps to expand its permit program to include marsh and wetland areas not covered previously. The Corps then indicated that its authority might extend as far as farm ponds and irrigation ditches. The U.S. Department of Agriculture and others objected to this assertion. However, under the July 1975 guidelines,[182] Corps jurisdiction would extend to wetlands and other waters in three phases, but would define the discharge of dredged or fill material so as to exclude normal farming and certain other activities. The Corps is currently considering additional revisions to clarify further the scope and intent of their permit program.

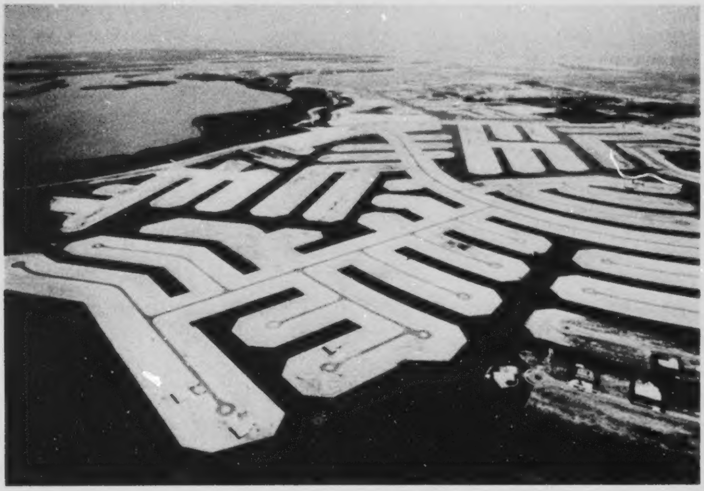
The Corps has also been conducting a review of existing capabilities of the states to regulate dredge and fill activities in coastal and inland waterways and wetlands. Results will provide a basis for evaluating the numerous extant legislative proposals to delegate to the states some or all of the Corps' regulatory authority. Congress, as of July 1976, has been actively considering other proposed amendments that would restrict the Corps' present court-determined jurisdiction.

The Corps, pursuant to its authority under Section 404, denied two applications by a private developer to dredge and fill approximately 2,000 acres of mangrove swamp and associated wetlands for the expansion of a second-home and resort community at Marco Island in Collier County, Florida. This decision was announced by the Chief of Engineers in April 1976, and was widely viewed as establishing a precedent for careful federal regulation of development in wetland areas.

Navigation

Proposals for user charges to recover the federal share of waterway construction and/or operation and maintenance costs remained under active consideration by the Administration and Congress. The WRC Section 80 study showed that direct federal obligations for navigation purposes in FY 1974 totaled more than $659 million, with effective non-federal cost sharing only 7 percent. This contrasts with a 19-percent non-federal share for irrigation and water-based recreation purposes, and a 64-percent non-federal share for point-source water quality management and hydroelectric power development.[183] Cost sharing for navigation may be debated further after the President's expected general recommendations to Congress on cost sharing and other Section 80 study issues later this year.

We reported last year on the controversy surrounding proposals to replace and expand Locks and Dam 26 on the Mississippi River at Alton, Illinois.[184] After considering criticisms from the U.S. Department of Transportation, railroads, and environmental groups, the Army Corps of Engineers announced major revisions in the plan for this project. The revised plan, which is currently receiving agency and public review, proposes that initially one 1200-foot replace-



The artificial reefs constructed at Marco Island, Florida, have replaced the mangrove swamp—productive wetlands (Photo credit: U.S. Environmental Protection Agency—Documerica, Flip Schulke)

ment lock be built instead of two, and that extensive environmental studies be undertaken before a final decision is made on whether to build the second lock.[185] The Corps will seek specific congressional authorization for this plan.

Flood Damage Reduction

Federal expenditures for urban and rural flood damage reduction totaled several hundred million dollars in both FY 1975 and FY 1976.[186] Actual flood damages were estimated to exceed $2.2 billion for calendar year 1975.[187] These numbers reveal the continuing costs to federal taxpayers and property owners of unwise floodplain development and inadequate local floodplain zoning and management.

Acceleration of both federal and non-federal efforts is necessary to substitute floodplain management alternatives for structural flood control measures wherever feasible. Although regulations adopted by HUD for the NFIP[188] should improve local land use planning in identified flood hazard areas, comparable specific regulations for federal activities in floodplains do not yet exist. The WRC is drafting a new Executive Order to update the older, more general Executive Order 11296. This new Executive Order would require federal agencies to adopt appropriate regulations for minimizing the flood damage potential of their activities. The proposal will be considered by the Administration.

Recent efforts by the federal government have been directed toward achieving a better balance between structural measures intended to control the flow of floodwaters and nonstructural measures designed to promote uses of flood-prone lands which are more compatible with occasional flooding and less destructive of the natural environment. Structural measures include the use of dams and reservoirs, levees, and river channel alterations. Nonstructural measures include local and statewide floodplain development regulations; acquisition of floodplain lands for recreation, fish and wildlife habitat, and other public purposes; flood warning systems; floodproofing of existing structures; and adequate flood insurance in association with effective local land use planning and zoning.

During the past year, the Federal Insurance Administration (FIA), with assistance from the Army Corps of Engineers and the Soil Conservation Service, has accelerated the detailed mapping of flood hazard areas previously identified in 22,000 communities across the country. This work is an essential part of the NFIP, as expanded by Congress in 1973. This insurance program makes flood insurance available to property owners in identified flood hazard areas, provided that the local community takes certain planning and regulatory steps to qualify for the program. As of March 1976, 13,394 communities had qualified for the emergency program, and 583 were participating in the regular program. Approximately 3,700 other communities identified and mapped by FIA were not yet participating in either program.[189]

The NFIP places restrictions on federal aid to development in mapped flood hazard areas of nonparticipating communities. Although Congress acted in June 1975 to extend the effective date of such restrictions, other legislative attempts to weaken the NFIP were not successful.

In another federal effort to promote better planning for use of flood-prone lands, the WRC released in April 1976 a report entitled "A Unified National Program for Floodplain Management." [190] The report presents a conceptual framework for coordinated management, and discusses a number of measures for flood loss reduction in flood hazard areas.

Water, Energy, and Agriculture

The Westwide Study. Future planning for water resources development in the western United States will move away from project-oriented solutions toward programs emphasizing total water management, water conservation, and the environment. This was the principal conclusion of the Westwide Study, which was authorized by Congress and conducted by the U.S. Department of the Interior to evaluate critical water problems facing the 11 western states.[191] The study report, released in February 1976, recommends 72 specific federal investigations to find solutions to mounting pressures on the region's limited water supplies for energy resource development, agricultural production, environmental protection, and Indian needs.

The Powder River Basin. Plans recently announced by private coal interests to develop the extensive coal reserves in the northern Great Plains have intensified the controversy over alternative uses of water in that region. The process of mine-mouth conversion of coal to synthetic natural gas involves the consumption of large quantities of water, as does the alternative of transporting the coal out of the region as a slurry (pulverized and mixed with water) in pipelines.

One such plan would require 6.5 billion gallons of water annually to move 25 million tons of coal each year for the next 30 years. This coal would be moved from the Powder River Basin in Wyoming via slurry popeline across 1,000 miles to Arkansas, where the coal would be burned to generate electricity.[192] The water would come from the Madison aquifer, a huge underground water-bearing rock formation underlying parts of the Dakotas, Montana, Nebraska, and Wyoming.

Opposition to such plans has come from farmers and railroad officials, and the state of Montana among others, who argue that large-scale withdrawals could lower ground water levels, reduce the flow of streams and springs, and lower water quality in existing wells. Thus, these withdrawals could adversely affect agricultural and municipal users in several states. The railroads offer an alternative method of transporting the coal. There are also legal questions about ownership of water rights, which may have to be resolved by the federal courts.

In February 1976, the U.S. Geological Survey announced that a comprehensive study was underway to determine the availability of ground water to meet future needs in a 188,000-square-mile region that includes the Powder River Basin.[193] The study will require several years of data collection and analysis, which will include the development of a computer model to simulate ground water flows in the Madison formation.

MINERALS

Mining and Minerals

Conflicts between modern mining techniques and the preservation of scenic beauty, recreation values, and natural ecosystems marked the debate over mineral development on public lands during the past year. Proposals were considered to prohibit surface mining from National Parks. Other subjects debated were how extensively other public lands should remain open to mining, how to reconcile mining with other uses of the public lands, and how to reclaim land that bears old scars from surface mining.

Mining in the National Parks

Plans to expand borate mining in Death Valley National Monument focused public attention in 1975 on mining in the National Parks. Mining is generally prohibited, but in some parks pre-existing rights under the old 1872 Mining Law have been preserved; special legislation has opened other parks to mining.

Congress enacted special legislation opening Death Valley to mining[194] under the 1872 Mining Law 4 months after the area was proclaimed a National Monument by President Roosevelt in 1933. At that time no one contemplated large-scale surface mining within the Monument. Today there are seven operating talc mines and two operating borate mines.

At this writing, the Senate has passed a bill to impose a moratorium on mining in Death Valley, and the House is expected to follow suit.[195] The moratorium would not shut down ongoing mines, but would permit no new land disturbance pending a study by the U.S. Department of the Interior to determine the validity of the existing rights in Death Valley National Monument, Mount McKinley National Park, and Organ Pipe Cactus National Monument and to recommend to Congress whether any valid or patented claims should be acquired by the United States. The bill would also repeal the laws that permit the staking of new mineral claims in Coronado National

This borate mine, 2000 by 600 feet and 280 feet deep, in Death Valley National Monument, focused public attention on surface mining in the National Parks and on other public lands (Photo credit: U.S. Department of the Interior, National Park Service, Breyne Moskowitz)

Memorial, Crater Lake National Park, Death Valley National Monument, Glacier Bay National Monument, Mount McKinley National Park, and Organ Pipe Cactus National Monument.

The Sierra Club has filed suit against the Department of the Interior, listing the Death Valley National Monument itself as a plaintiff and stating that the Secretary of the Interior has a trust responsibility to protect the Monument. The suit asks that this trust be fulfilled by such measures as the promulgation of regulations which would prohibit surface mining or require effective reclamation, prohibiting the expansion of existing mines and the withdrawal of certain areas of the Monument from the Mining Law of 1872.[196]

Phosphate Mining on Public Lands

Other significant mining activity on the public lands involves three proposals to mine phosphates, mostly on National Forest lands. The Interior Department has delayed issuance of preference right leases in Florida on the Osceola National Forest pending studies on the environmental effects of mining 120 million tons of phosphates.[197] These studies include the effects of mining on endangered species and the hardwood swamp ecosystem in the Osceola National Forest, and the radiation hazard from exposing radioactive material.

Preference right leases are automatically granted anyone with a valid prospecting permit having discovered a mineral deposit in "commercial quantities" or a "valuable deposit." The Interior Department has promulgated a new definition of "commercial quantities" and "valuable deposit" which employs the same considerations used by Interior to determine whether or not a mining claim is valid under the 1872 Mining Law. These considerations are:

- Quantity and quality of minerals.
- Estimated reserves.
- All estimated costs, including developing the mine; removing the material; processing necessary to place the mineral in a salable condition; transporting the mineral to the point of sale; applicable royalties and taxes; and complying with existing governmental regulations, reclamation and environmental standards, and proposed lease terms.
- Comparison of estimated cost and estimated revenues.[198]

Preference right leases were issued previously without such a test.

In Idaho, there are proposals to mine 285 million tons by the year 2000, primarily in the Caribou National Forest. The Interior Department is considering 3 applications for competitive leases covering 3,400 acres and 4 preference right lease applications covering 2,500 acres; an additional 30 leases are up for renegotiation of terms. There are two phosphate mines now operating within the National Forest, and another in the nearby Fort Hall Indian Reservation. Grazing is a leading current use of the Caribou National Forest, which contains an important population of whooping cranes. These cranes were introduced to the area and are being raised by foster parents, sandhill cranes.[199]

The third phosphate proposal involves issuing a 2,500-acre preference right lease to mine 100 million tons of phosphate on the Los Padres National Forest in California. The area is habitat for the endangered California Condor.[200]

Withdrawals From Entry Under the Mining and Leasing Laws

Over the past year, the whole process of withdrawing lands from entry under the mining law and the leasing laws has come under scrutiny.[201] Much of the public land closed to mining at present consists of Alaskan lands, temporarily withdrawn until native claims are settled and remaining public lands are allocated to one of four public lands systems (National Parks, Wildlife Refuges, National Forests, and Wild and Scenic Rivers). In fact, two-thirds of the increase in withdrawals since 1968 is due directly to the Alaskan Native Claims Settlement Act (ANCSA). When the provisions of ANCSA are settled, more than 100 million acres[202] will probably be returned to public domain status open to mining. The native corporations that have chosen lands with development potential will begin programs to exploit the minerals on their newly acquired lands. Some land within the four public lands systems will be open to mining.

The Interior Department is studying ways to ensure that withdrawals are kept to a minimum; however, under present law, withdrawal is often the only available management tool.

The Mining Law of 1872 has generally been interpreted as leaving federal land management agencies no discretion to manage and control mineral development. Anyone who makes a valid claim under the law owns the mineral under the claim; further, the claimant can gain ownership of the land itself for a nominal price. Lacking any degree of regulatory authority, a land management agency may choose to close completely an area to mining. The choice has been between absolutely no mining or absolutely no control.

Reclamation

Reclamation of old and new mine sites has become the subject of much needed research and demonstration. Surface, Environment, and Mining (SEAM) is a Forest Service program, begun in 1973, to make mining as compatible as possible with other uses of the National Forests, and to plan restoration of the land after mining. In cooperation with private industry, other government agencies, and universities, SEAM conducts reclamation research and demonstrates model reclamation.

SEAM is attempting to find workable methods of reclaiming strip mines and open pit mines, new and old, in all parts of the country. Entire watersheds in the west in which there was extensive gold, silver, and lead mining in the 19th and early 20th century are still being polluted from old mine shafts and tailings dumps. One of SEAM's pioneering projects is a modestly scaled, moderately priced effort to reclaim an old tailings dump in the Lynx Creek watershed of the Prescott National Forest, Arizona. The project, funded by SEAM and supervised with the University of Arizona, will improve the water in a recreation reservoir intended for trout fishing to the point where the trout can survive. The cost was $20,000 to lime and revegetate the dump with grass, and to rearrange the drainage.[203]

RENEWABLE RESOURCES

Grazing

Range Condition and Programs. The condition of the nation's rangeland is cause for concern. Thomas Kleppe, Secretary of the Interior, in February told the Society for Range Management that 83 percent of the national resource lands under the Bureau of Land Management (BLM) is in "something less than satisfactory condition."[204] In the "Assessment" required by the Forest and Rangeland

Renewable Resources Planning Act (RPA),[205] the Forest Service reported that almost three-fourths of the rangeland, public and private, is in fair or poor condition.[206]

More than 15 million acres of grazing land in our National Forests is also in unsatisfactory condition in terms of forage and soil deterioration. The costs of these unsatisfactory conditions are substantial, in loss of forage for domestic livestock and wildlife and loss of water quantity and quality. The Forest Service estimates that correction of unsatisfactory conditions in the National Forests would cost approximately $92 million.[207] This effort would be part of a long-term program also designed to make effective use of National Forest ranges for production of red meat.

The RPA range assessment is based primarily on the Forest Service's 1970 Forest Range Environmental Study (FRES),[208] whose goal was to determine range capability to meet the nation's needs. In order to test FRES findings, the Forest Service proposed to institute three major validation studies. The first of these studies, a 10-year program in the Blue Mountains of Oregon, began in 1976 at a cost of $1.4 million for the first year.

The Secretary's Office and BLM of the Department of the Interior have taken action during the past year to correct serious range problems. After BLM's Nevada report,[209] which documented the deteriorated conditions of public rangeland in that state, BLM planned to defer Nevada national resource lands to grazing for a minimum of 2 months during the critical spring growing season, where the physiological requirements of the plant are not being met. This policy will hold except in areas where BLM has fully implemented grazing allotment plans that are achieving the objective of rangeland protection. The Interior Department has taken additional steps to correct deficiencies in the range program and to ensure that federal investments for livestock grazing management on public lands are wisely and prudently made.

Curt Berklund, Director of the Bureau of Land Management, issued revised range management policy guidelines in August 1975 that include these goals:

- Achieve multiple use objectives, identified through the planning process, which include reaching and keeping an acceptable level of rangeland condition and enhancing environmental values.
- Provide forage to help meet the nation's needs for red meat and to help stabilize the economy of the livestock industry.
- Provide protection, management, and control for wild horses and burros as an integral part of a balanced natural system.[210]

BLM states that "first and foremost, range policy will be geared to improving all resource conditions to an acceptable level." [211]

Grazing Fees. The U.S. Departments of Agriculture and the Interior began a program in 1969 to raise grazing fees annually on public lands with the 1980 goal of reaching fair market value, or comparability between fees on private lands and public lands. In

These cattle are on overgrazed rangeland. Eighty-three percent of the national resource lands administered by the Bureau of Land Management are in something less than satisfactory condition (Photo credit: U.S. Department of the Interior, Bureau of Land Management)

1976, BLM raised grazing fees from $1 to $1.51 per animal unit month (AUM) and the Forest Service raised fees in the western regions from $1.11 to $1.60 per AUM, which put the program of reaching fair market value on schedule.[212] An AUM is the equivalent of 1 month's grazing by a mature cow, five sheep, or one horse. Private land grazing for 1975 was $5.75 per AUM for the 11 western states.[213]

Timber

Timber and the Courts. Forest Service timber sale policies for the Monongahela National Forest in West Virginia were held illegal in August 1975, on grounds that they violate the 1897 Organic Act under which the National Forests are administered.[214] In a strict interpretation of the act's timber sale provision, the U.S. Court of Appeals for the Fourth Circuit ruled that the Forest Service can sell only timber that is dead, physiologically mature, and of large growth, and that each tree sold must be individually marked and removed from the forest. In December 1975, the U.S. District Court for Alaska applied the same ruling to a part of the Forest Service timber sale on the Tongass National Forest.[215]

The rulings severely limit forest practices that are currently in widespread use and raise fundamental questions about how the National Forests are to be managed in the future. The U.S. Circuit

Court of Appeals for the Fourth Circuit recognized the consequences of its decision and has suggested that a legislative remedy might be appropriate. Most parties to the dispute agree that a new law is needed, but do not agree on the content of its provisions.

Some environmental groups feel there is too much National Forest management emphasis on timber and too little on the other renewable resources. They also view most clearcutting for timber management as environmentally abusive and want the use of this method restricted in scope and regulated by legally enforceable standards.

The forest industry and many professional foresters oppose regulation of forest practices by law, believing that specific forest practices should be prescribed by professional foresters, not by Congress. They would prefer that Congress outline general policy guidelines within which the Forest Service would design and implement regulations thus allowing professionals to tailor practices to the site, thereby accommodating specific ecological requirements.

Several bills that reflect the opposing views are now in Congress and promise lengthy and thorough debate during the next few months.[216] Hearings have been held, and it now seems that a blending of the strength of each approach is a possible outcome.

Timber Supply and Demand. Timber is in reasonably good supply and has kept pace with growing demand in the past 30 years. The future, however, is uncertain. If prices for timber products remain stable relative to average prices of all commodities and to most competing materials, and 1970 management practices and policies continue, demand for wood may double by the year 2020, increasing faster than the projected supply from our native forests.[217]

Policies for timber management and harvesting in the National Forests have a substantial effect on the nation's timber supply, now and in the future. The National Forests currently supply about 25 percent of the nation's annual needs for softwood sawtimber. They are storehouses of 46 percent of the nation's softwood growing stock and 51 percent of the softwood sawtimber.[218]

Debate on timber management for National Forests has intensified during the past year. At the 100th anniversary meeting of the American Forestry Association, in a special issue of *Science* devoted to materials, and in many other forums, the subject attracted close attention. Much of the controversy concerned the rate of harvest and replacement of the old growth sawtimber stands that characterize most western National Forests. Such forests show little or no growth, and mortality is high. Faster removal of old growth would increase timber supplies in the short run, but would eventually cause a severe dip in sustained yield because the replacement trees would not be ready for harvest until some time after the old growth had been cut. Some economists and the timber industry say that this fact does not matter. Their point of view is that investing more money in intensive forestry, concentrating timber production on the more productive sites, and managing the National Forests in a businesslike manner will significantly reduce projected timber supply deficits.[219]

Intensive forestry, as practiced by the commercial forestry industry, carries some short- and some long-term ecological risks, however. Use of chemical pesticides and fertilizers, growing stands that are all of the same age, control of underbrush by fire or chemicals, and other practices intended to raise annual yields may prove to have unwanted effects. Furthermore, these practices are not always consistent with the Forest Service's legal mandate to manage its land for multiple use. National Forests can be managed for greater productivity under the governing principles of long-term conservation rather than maximum harvests in the shorter term.[220]

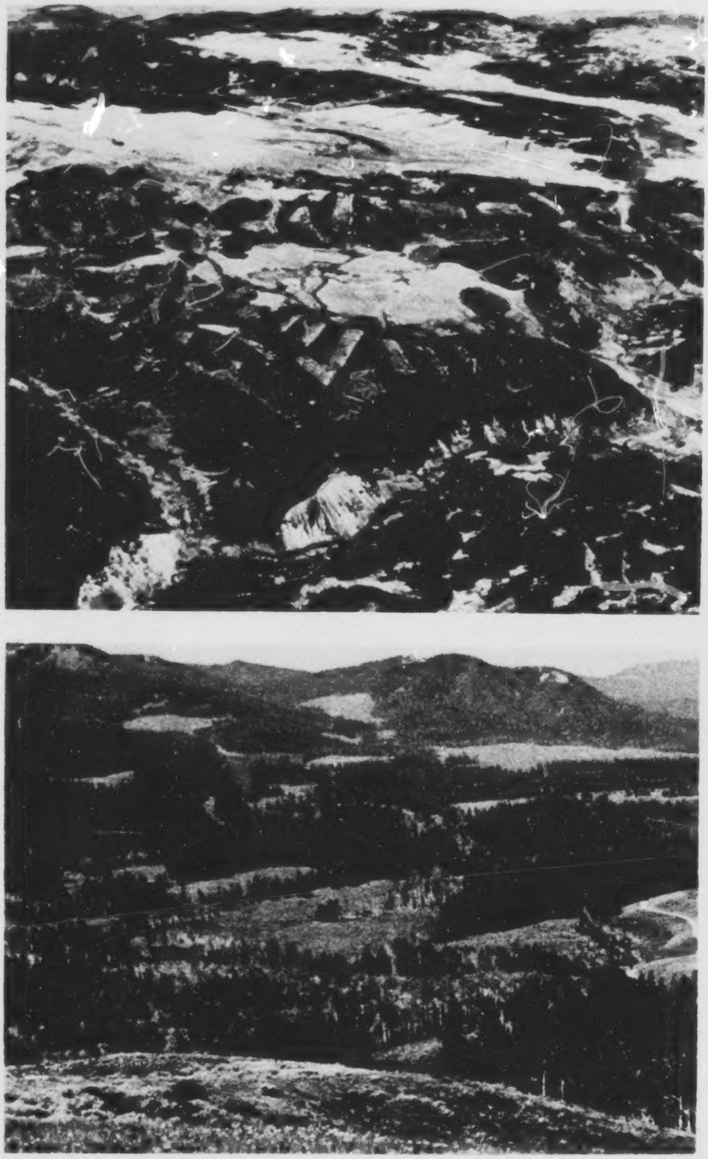
Water Pollution From Forestry Activities. Following a court order, EPA has issued final regulations for point sources of water pollution related to timbering. Previously, EPA had considered that water-borne pollution from timber harvesting arises from numerous small nonpoint sources, rather than central point sources that are amenable to effluent controls. The U.S. District Court for the District of Columbia ruled in June 1975 that EPA's definition of "point source" was contrary to the intent of Congress.[221] The ruling compelled EPA to develop effluent guidelines and a permit program for previously excluded sources by June 10, 1976.

EPA appealed the court's ruling, but issued regulations that set forth criteria for distinguishing between point and nonpoint sources of pollution and established a permit system.[222] The regulations list rock crushing, gravel washing, log sorting, and log storage operations as potential point sources of pollution subject to the permit system. Most other forestry activities are considered to be nonpoint pollution sources subject to state or area-wide wastewater treatment programs. The primary water pollution problem is from siltation.

Under provisions of the Federal Water Pollution Control Act, the states must develop programs to identify and "control to the extent feasible" nonpoint sources of pollution from forestry activities.[223] EPA advocates "Best Management Practices" for this purpose and expects each state to develop acceptable programs based upon EPA guidelines applicable to all public and private forest operations.

Parks and Recreation

Care of Our Heritage. As Table I-27 shows, visits to all of our public lands are increasing each year, and heightened public interest in the country's natural and historical heritage during the nation's bicentennial year has resulted in even more visits and special needs. The National Park Service (NPS), for example, which must play host to millions of visitors to the nation's capital, was granted additional positions in recognition of these special needs. Yet the year-in and year-out condition of the National Parks remains a major public concern.



(Top) Photo illustrates past clearcutting practices on National Forests which disregard visual impact. (Bottom) This photo shows the clearcut layout blended with the topography and natural openings to minimize adverse impact on the landscape (Photo credits: U.S. Department of Agriculture, Forest Service)

During the past several years, National Park visits and areas have increased significantly, but environmentalists feel that the NPS has not received corresponding increases in personnel. Last year visits to the parks increased 10 percent over those of the year before.[224]

At hearings held in April 1976 by the House Subcommittee on Conservation, Energy, and Natural Resources, the Office of Management and Budget (OMB) testified that a survey conducted by the National Parks and Conservation Association pointed out the need for better management of the National Parks.[225] Acting on this premise, OMB, in conjunction with the NPS and the Interior Department, is conducting a study scheduled to end in September 1977. This study will formally analyze NPS objectives, priorities, and management processes. The endpoint of this analysis will be a comprehensive Resource Management System that will use NPS budget and personnel efficiently for more effective management of the parks.

If the National Parks are to maintain the high standards of the past, a solution must be found to the problem of trying to do a big job with too few people. Preservation of resources versus visitor use will be a continuing problem. In some instances, public access may have to be limited in order to protect the parks from overuse.

Similar problems plague other public land systems, although they have not received as much attention. Table I-27 shows that recreational use is increasing on the public lands, creating new needs for facilities and services. Some of the visitors' demands for campgrounds, shelter, and food service should be met by private investment, either on private property adjacent to public lands, or on the public lands themselves in carefully supervised concessions. Yet the job of supervision, education, and preservation belongs to the public land managers, and that job is growing. To charge fees for recreation areas that now are without cost might be given future consideration as a means to finance service in parks and recreation areas.

New National Park Area. The National Parks have grown in recent years, adding 102 new areas since 1960. Many of the new areas were either national recreation areas or historic sites. Three new areas have been designated since June 1975. On March 17, 1976, President Ford signed Public Law 94-235, establishing the Chickasaw National Recreation Area in south central Oklahoma. The new area unites the lands formerly within the 912-acre Platt National Park and the 7,000-acre Arbuckle National Recreation Area by authorizing the acquisition of almost 1,200 acres between them. There is much pressure to continue this expansion.[226] The President signed Public Law 94-323 on June 30, 1976, to create the 13,271-acre Gold Rush National Historic Park in memory of the pioneers who led the 1898 rush for Alaskan gold. There is a provision in the law to establish an International Historical Park in conjunction with the Canadian government. On July 4, 1976, in commemoration of the bicentennial, President Ford signed Public Law 94-337, creating Valley Forge National Historical Park, formerly

TABLE I-27. Recreational use of our public lands (in millions): 1970-1975

Agency	1970	1971	1972	1973	1974	1975
Bureau of Reclamation (visitor days [a])	54.2	55.7	55.8	56.4	63.8	64.7
Bureau of Land Management (recreation visits [b])	67.2	91.2	84.6	95.4	89.8	NA
Corps of Engineers (recreation days [c])	276.0	310.0	328.0	344.0	352.0	376.0
Fish and Wildlife Service (number of visits [d])	17.9	19.0	20.2	[illegible]9.6	21.5	NA
Forest Service (visitor days [e])	172.6	178.1	184.0	188.2	193.0	199.2
National Park Service (number of visits [f])	172.0	200.5	211.6	215.6	217.4	238.9
Tennessee Valley Authority (number of visits [g])	56.7	57.6	60.3	61.3	61.9	65.6

[a] Defined as significant amount of time spent by one individual in a specific activity during a 24-hour period.

[b] Defined as a visit by a person to lands and waters under the jurisdiction of the Bureau of Land Management to engage in any activities except those that are part of or incidental to the pursuit of gainful occupation whether for a few minutes or a full 24-hour day.

[c] Defined as a standard unit of use consisting of a visit by one individual to a recreation development or area for recreation purposes during any reasonable portion or all of a 24-hour period.

[d] Defined as one person entering and exiting a National Fish and Wildlife Refuge.

[e] Defined as recreational use of National Forest land and water which aggregates 12 person hours; may entail 1 person for 12 hours, 12 persons for 1 hour or any combination of individual or group use, either continuous or intermittent.

[f] Defined as entry of a person into an area administered by the National Park Service such that he makes some use of the services or facilities it provides.

[g] Defined as one person entering and exiting an area of the Tennessee Valley Authority.

NA=not available.

a state park. The 2,500-acre park includes not only the area where the 1777-1778 encampment took place, but also the house used by George Washington in 1760.[227] More than 40 bills are now before Congress proposing authorizations of new areas of the National Parks.

Access to Recreation Opportunities. In August 1975, the Secretaries of the Departments of Transportation and the Interior transmitted to Congress a report on the problem of user access to recreation areas.[228] The report cited several recurrent problems in gaining access to recreation opportunities:

- Congestion at approaches to recreation sites during peak use periods.
- Inadequate transportation systems within recreation areas.
- Lack of adequate transportation access.
- Haphazard private development adjacent to recreation areas.
- Degradation of the physical environment with overaccommodation of users and heavy reliance on private automobiles.

The report also stated that recreation planning generally fails to consider transportation and access issues.

Land and Water Conservation Fund. Congress is working on amendments to the Land and Water Conservation Fund Act. The

House version proposes an incremental increase in the fund from the current $300 million to $800 million by 1980. This proposed amendment would also provide a greater proportion of the fund to heavily populated areas if more than $240 million of it is appropriated for state purposes. Passage of such an amendment would provide more money for the land acquisition programs of the National Park Service, the Forest Service, Fish and Wildlife Service, the Bureau of Land Management, and also for state recreation grant programs.

Hells Canyon National Recreation Area. After 20 years of controversy, Hells Canyon and the Middle Snake River were exempted from further dam development when President Ford signed the Hells Canyon National Recreation Area Act on December 31, 1975,[229] establishing the 662,000-acre Hells Canyon National Recreation Area (NRA) in Idaho and Oregon. Hells Canyon, the deepest canyon in North America, is not only unparalleled scenically, but is also noted for many types of fish and wildlife. It is especially important for giant sturgeon, small mouth bass, and for salmon and steelhead runs.

Redwood National Park Problems. Logging in areas contiguous to, but outside the boundaries of, Redwood National Park remains a problem for the NPS and a threat to the preservation of some coastal redwood groves. The Department of the Interior was ordered by a district court in July 1975 to take the actions necessary to prevent ecological damage to Redwood National Park.[230] The NPS is presently using cooperative agreements with the timber companies to provide some minimal, although still inadequate, protection of the areas.

Predator Control. The routine use of poisons for predator control on public lands was terminated on February 8, 1972, by Executive Order 11643. On May 28, 1976, President Ford amended the original order to allow the use of sodium cyanide in accordance with the regulations and restrictions prescribed by EPA. The amendment, Executive Order 11917, also sets a series of restrictions on poison use, including a prohibition of "any areas where exposure to the public and family pets is probable."

Safety has been one of the central concerns in the continuing controversy over predator control, particularly in view of the mounting numbers of people using our wild lands. The problem was underscored on Easter Sunday, 1976, when the son of a Texas rancher, on a Boy Scout backpacking trip, was shot in the face by an M-44.[231] This is a spring-loaded device placed on the ground intended to propel a lethal dose of cyanide into the mouth of a coyote when it tugs a triggering mechanism. Fortunately, the boy survived, but his experience emphasizes the potential danger to the public posed by current predator control activities.

Offroad Vehicles (ORVs). The State Director of the Bureau of Land Management in California denied the application for the ninth annual running of the Barstow-Las Vegas Thanksgiving Day Motorcycle Race.[232] The San Gabriel Valley Motorcycle Club, sponsors of the event, had requested a permit for a race involving 2,500 riders. The permit was denied, based on last year's environmental studies and monitoring program, which revealed unacceptable levels of environmental damage to the 155-mile desert race course.

BLM acted to terminate what was becoming a damaging tradition. However, although the BLM action on the motorcycle race was welcome news, conservationists are concerned that BLM is not moving fast enough in general to protect fragile national resource lands from damage by ORVs. By means of a number of independent study efforts, evidence of adverse impacts from undesirable use continues to grow.

Under court order to rewrite its ORV regulations,[233] BLM will issue proposed regulations early this year. A revised environmental impact statement will be issued which will cover all of the ORV regulations of the Interior Department.

Other public lands agencies are continuing studies to determine which areas should be open or closed to ORV use. Unfortunately, environmental damage can occur while studies are being made. An approach that expressly limits ORV use could avert some damage. To emphasize this approach, on November 12, 1975, the Society of American Foresters adopted the position that "In order that control be effective, off-road vehicles should be allowed only on forest roads, trails and areas . . . which are explicitly designated for off-road vehicle use. Experience shows this approach to be less costly, and easier to enforce than a restriction in which off-road vehicles are allowed on all forest roads, trails and areas except where designated to the contrary." [234]

Wild Areas

National Wilderness Preservation System. The National Wilderness Preservation System today consists of 127 areas, totaling approximately 13.1 million acres. Only two new areas have been added to the Wilderness System since June 1975. When Congress established the Hells Canyon National Recreation Area,[232] it designated 200,000 acres within the area as Wilderness. The other addition to the Wilderness System was the 230,000-acre Flat Tops area in west central Colorado.[235] There are currently more than 100 Administration Wilderness proposals pending before Congress.

Since June 1975, Congress has established four new areas to be studied as to their "suitability" or "nonsuitability" as Wilderness. These four new study areas are: Lord Flat Somers Point Plateau, Mountain Sheep, and West Side Reservoir Face (all three in the Hells Canyon NRA), and within the extended boundary of the Grand Canyon National Park.[236]

Although lands administered by the Bureau of Land Management were not included in the 1964 Wilderness Act, BLM does provide protection and preservation of some areas through administrative designation. In 1975, BLM designated four new Primitive Areas, totaling 70,000 acres. The new Primitive Areas are: Chemise Mountain in California, Centennial Mountains in Montana, Paiute in Arizona, and Scab Creek in western Wyoming. BLM also added new areas to review for Primitive Area status last year.

Wild and Scenic Rivers System. Since the inception of the Wild and Scenic Rivers System in 1968, 17 rivers have received the special designation. Table I-28 lists these rivers, their length, and classification. Five rivers, totaling 175.1 miles, have been added since June 1975, the 66.9-mile portion of the middle Snake River through Hells Canyon; 24 miles of the Rapid River, Idaho (also within the Hells Canyon NRA); 33 miles of the Little Beaver River in Ohio;[237] the New River in North Carolina; and 25 miles of the Lower St. Croix River in Minnesota and Wisconsin. Congress has had many "study river" bills before it since June 1975; however, only 33 miles of the Snake River north of the Hells Canyon NRA to Asotin, Washington, was designated a "study river" for possible inclusion in the system.

On March 13, 1976, Secretary of the Interior Thomas Kleppe announced his intention to approve North Carolina's proposal to designate a 26.5-mile segment of the New River as a state-administered component of the National Wild and Scenic Rivers System.[238] The New River (which is geologically very old) has outstanding natural,

This part of the New River in North Carolina was recently incorporated into the Wild and Scenic Rivers System. The future of the river is uncertain, however, because the Federal Power Commission has granted a license to a power company to construct two hydroelectric dams on the river (Photo credit: U.S. Department of the Interior, Bureau of Outdoor Recreation)

TABLE I-28. River mileage classification for components of the national Wild and Scenic Rivers System

River	Administering U.S. agency	Miles by classification			Total miles
		Wild	Scenic	Recreational	
1. Middle Fork Clearwater: Idaho •	Forest Service	54	—	131	185
2. Eleven Point: Missouri •	Forest Service	—	44.4	—	44.4
3. Feather: California •	Forest Service	32.9	9.7	65.4	108
4. Rio Grande: New Mexico •	Bureau of Land Management/Forest Service	51.75	—	1	52.75
(Rio Grande Management by agency)	(Bureau of Land Management)	(43.90)	—	(0.25)	(44.15)
	(Forest Service)	(7.85)		(0.75)	(8.60)
5. Rogue: Oregon •	Bureau of Land Management/Forest Service	33	7.5	44	84.5
(Rogue Management by agency)	(Bureau of Land Management)	(20)	—	(27)	(47)
	(Forest Service)	(13)	(7.5)	(17)	(37.5)
6. St. Croix: Minnesota and Wisconsin •	National Park Service	—	181	19	200
7. Middle Fork Salmon: Idaho •	Forest Service	103	—	1	104
8. Wolf: Wisconsin •	National Park Service	—	23.5	0.5	24.0
9. Allagash Wilderness Waterway: Maine	State of Maine	95	—	—	95
10. Lower St. Croix: Minnesota and Wisconsin	National Park Service	—	12	15	27
11. Chattanooga: North Carolina and South Carolina	Forest Service	39.8	2.5	14.6	56.9
12. Little Miami: Ohio	State of Ohio	—	18.0	48.0	66.0
13. Little Beaver: Ohio	State of Ohio	—	33.0	—	33.0
14. Snake: Idaho and Oregon	Forest Service	32.5	34.4	—	66.9
15. Rapid: Idaho	Forest Service	24.0	—	—	[illegible]4.0
16. New River: North Carolina	State of North Carolina	—	26.5	—	[illegible]6.5
Total		465.95	392.5	339.5	[illegible]7.95

• Denotes "instant" rivers.

historical, and recreational qualities. It is also the proposed site of the Blue Ridge Project, a two-dam hydroelectric power project of the Appalachian Power Company. However, on March 24, 1976, the U.S. Court of Appeals for the District of Columbia rejected a challenge by the state of North Carolina to a license for the Blue Ridge Project issued by the Federal Power Commission in 1974,[239] thereby confirming the commission's decision. Nevertheless, on April 13, 1976, Secretary Kleppe designated the 26.5-mile segment of the New River as a component of the system.[240] In addition, North Carolina officials and congressional supporters of preserving the New River said they would move to prevent any dam construction through further appeal and legislative processes.[241]

Wildlife

State-Federal Relations. State-federal relations have been a major wildlife issue in recent months. Problems of blackbird control in Kentucky and Tennessee and wolf control in Alaska involved state desires and needs that were in conflict with federal responsibilities.

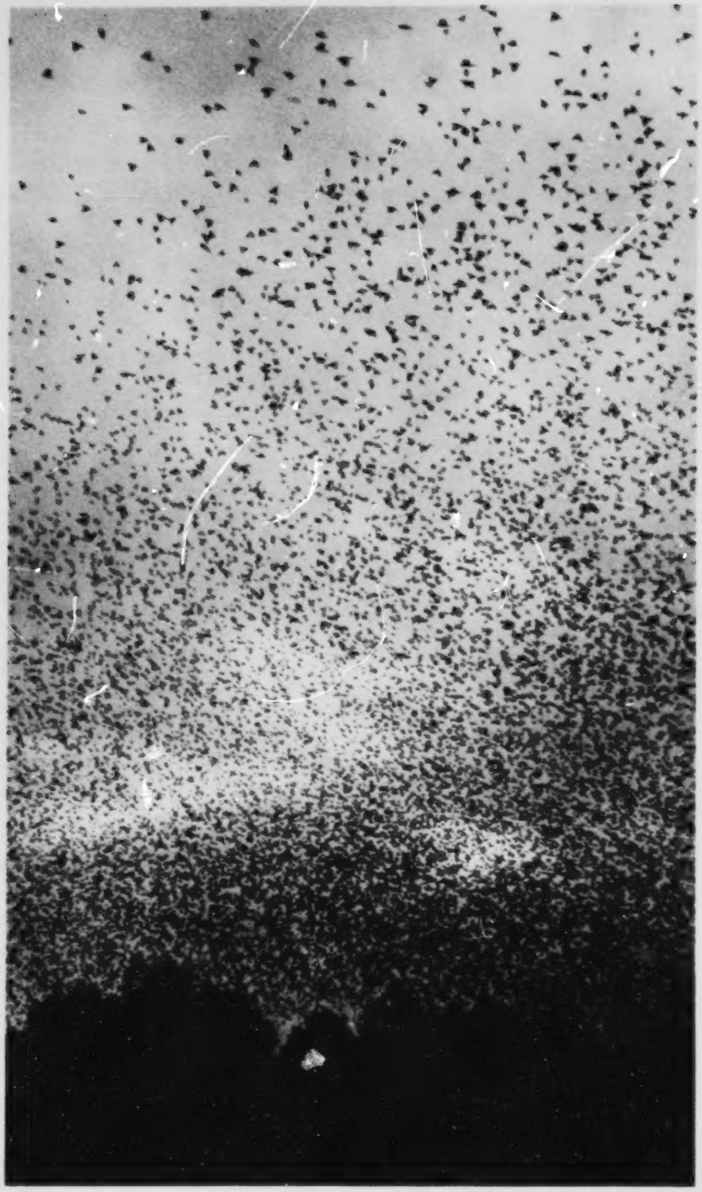
A few of the roosts of millions of blackbirds in Kentucky and Tennessee have become a serious problem to persons living nearby.[242] In response to local concern, Congress enacted a law in January 1976 temporarily suspending federal National Environmental Policy Act (NEPA) requirements and international treaty obligations, giving the states full power of decision to destroy the birds.

The birds were thought to be a threat to crops and health as well as a nuisance. The malodorous layer of fecal material, inches thick, in the woods where the birds roost is a medium for growth of the fungus that causes the lung disease histoplasmosis. Incidence of the disease has apparently increased locally along with the blackbirds, and several cases have been fatal.[243]

The blackbird problem is one of ecological imbalance. The roosts include not only three native species—redwing blackbirds, common grackles, and brown-headed cowbirds—but also the recently introduced European starling.

Starlings are a major part of the problem, although they are not the most numerous species in all roosts. Another factor in the ecological imbalance is the abundance of food from wastes left behind by mechanized agriculture. These wastes have probably increased several-fold the food available for wintering birds in the past 2 decades. Another factor fostering a surge in the blackbird population is the mild winter temperatures of the past few years.

Mild winter weather also hampered the control technique, which is to spray the birds with a biodegradable detergent to destroy their natural waterproofing, and then wet them so they freeze to death.[244] Spraying, carried out in March by Army troops, trucks, and helicopters, authorized by the temporary blackbird bill,[245] succeeded in



Blackbirds darken the sky in Milan, Tennessee. This winter millions of birds roosted in Kentucky and Tennessee, creating a nuisance as well as a potential threat to crops and health (Photo credit: U.S. Department of the Interior, Fish and Wildlife Service, Brooke Meaney) killing only about half a million birds, when the expected rain and cold weather did not materialize.

The bill, passed by Congress without committee hearings or floor debate, bypassed an existing law which allows emergency spraying with the permission of the Fish and Wildlife Service. Also bypassed was NEPA; an environmental impact statement was in preparation when the bill was passed and signed into law by the President. The law expired on April 15, 1976. The problem persists, however, and the blackbirds will be back next winter.

A second issue concerning state-federal relations in wildlife management arose when Alaska initiated a wolf control effort as part of a reimbursable research program under the Pittman-Robertson Act. This act provides for transferring federal taxes collected from the sale of sporting guns and ammunition to the states. In 1975, the U.S. Fish and Wildlife Service reviewed and accepted a $2 million Alaskan statewide wildlife program, including the wolf control portion funded at about $10,800.

After examining NEPA implications, the Fish and Wildlife Service suspended reimbursement for wolf control pending an assessment of the situation.[246] The Service subsequently determined that the Pittman-Robertson program is subject to NEPA, and it will conduct an impact assessment of the wolf-killing project before accepting a request to reimburse Alaska for the project. The Alaska wolf situation crystallized the need for better evaluation of management and funding programs, and the Fish and Wildlife Service is now preparing a programmatic impact statement for the entire Pittman-Robertson program.

After the problems regarding blackbird and wolf control were addressed by lower courts, the Supreme Court in a case [247] challenging the constitutionality of the Wild Free-Roaming Horses and Burros Act,[248] clarified the federal control of wildlife. The Supreme Court held that the act is a constitutional exercise of the federal government's proprietary power in public lands. As a result, it is now clear that the federal government has the power to control and protect wildlife on federal lands, even where there is no damage to habitat. The court, however, expressly reserved the larger question of whether wildlife generally is owned by the states or the federal government, thus putting into question the frequent assertions of states that wildlife is always state property.

Endangered Species. The Interior Department was designated the sole management authority of the recently ratified international convention on endangered species of plants and animals, by Executive Order 11911 on April 13, 1976.[249] Up to this time, the Fish and Wildlife Service had not listed endangered plants for protection, but progress has been rapid. To further implement the convention, the Fish and Wildlife Service has reorganized its permit system by consolidating its various authorities under the Lacey Act, Migratory Bird Treaties, the Federal Endangered Species Act of 1973, and the convention.

A key step to protect marine wildlife from overexploitation was taken when President Ford signed the Fishery Conservation and Management Act of 1976 into law on April 13, 1976.[250] This landmark law extends the U.S. jurisdiction for living marine resources, such as fish, lobster, shrimp, and other valuable marine animals, from 12 miles to 200 miles. Regional councils, representing many interests including conservation, will set regional optimum quotas based on scientific management information for the stock to be exploited. U.S. fishermen will be given preference in harvesting the stocks, and the rest of the quota will go to foreign fisheries under bilateral agreements with the United States. The law provides for strict protection of species that may fall below the optimum level in the future and allow stocks presently below this level to recover. Marine mammals including whales and dolphins continue to be governed by the Marine Mammal Protection Act of 1972.

Continued progress toward whale conservation was made at the Annual Meeting of the International Whaling Commission held in London.[251] Quotas were reduced from the 1975 quota by 5,997 whales. Overall quotas have been reduced from 45,673 whales in 1973 to 27,939 whales for 1976. The United States continued to press without success for a 10-year moratorium on commercial whaling.

Wildlife Refuges. For the past 2 years, there has been a continuing debate in Congress and the Executive Branch about conflicting authorities over the National Wildlife Refuge System. In particular, there was controversy over the Secretary of the Interior's decision to put BLM in sole charge of the Charles Russell, Charles Sheldon, Kofa, and Desert Game Ranges, ending joint administration by BLM and the Fish and Wildlife Service. In 1976, Congress enacted a law vesting sole management authority for these lands in the Fish and Wildlife Service, and requiring specific congressional approval before wildlife refuge land may be sold, redesignated, or transferred to other land management agencies.[252]

The refuge system itself is at a crossroad. A thorough examination of the objectives, management, philosophy, and funding of the system is currently underway. One major area of increased emphasis is in non-game species management. In 1975, only 3.5 percent of all wildlife management funds and 25 percent of all research funds spent by the Fish and Wildlife Service and 12 other federal agencies were for non-game wildlife programs.[253] The emphasis on game management on wildlife refuges in the past has often had ancillary benefits for non-game and endangered wildlife. The need still remains, however, for ecosystem management in which all species are considered.

Resource Assessment and Planning

Forest Service Renewable Resources Program. Assessment by the Forest Service of the nation's 1.6 billion acres of forest and rangelands, and its long-term (through the year 2020) program for the National Forests were completed on December 31, 1975, as directed by the Resource Planning Act of 1974.[254] The program recommended to the President integrates the diverse resource activities of the Forest Service into a single, comprehensive, goal-oriented program.[255] Its intent is to draw from the nation's abundant resource lands more supplies of services and goods at reasonable cost, and with positive effects on the environment. Some program highlights are:

- *Recreation.* Increase in supply of outdoor recreation opportunities and services emphasizing dispersed use to accommodate 10 to 20 percent more use than at present.
- *Wilderness.* Provision of moderate, but significant increases in designated wilderness, up to 30 million acres by the year 2020, about double the 1975 acreage.
- *Wildlife and Fish Habitat.* Substantial increase in habitat management to provide for greater species diversity and larger wildlife and fish populations, together with protection of threatened and endangered species.
- *Range.* Provision of forage to the extent benefits are commensurate with costs, without impairing land productivity. The program would also improve range conditions for other values, such as watershed protection and wildlife.
- *Timber.* Increase in timber supplies and quality to the point where benefits are commensurate with costs. By concentrating investments on the most productive sites in the National Forests, potential yields in 2020 could be 20 to 50 percent greater than in 1975. The greatest opportunity to increase timber supplies, however, is on privately owned non-industrial timberland.
- *Soil and Water.* Improvement in soil productivity, air and water quality, with selective improvement in water supply, commensurate with benefits.

The President recommended the program to Congress "as an aid to charting our course for the next few years . . . ." Congress is expected to evaluate the program when it considers changes in the timber sale limitations imposed by the Organic Act of 1897.

Bureau of Land Management Organic Act. The mission and authority of BLM to manage the 450 million acres of public land it administers is derived from almost 3,000 public land laws. These laws are often overlapping, incomplete, or conflicting, and some date back more than 170 years. Congress has, for several years, considered enactment of a law which would be a mission statement for BLM and would give it modern and adequate administrative authority.

The Senate passed such a bill in February, the House in July, but the House version contains some differences and is more protective of commodity interests. The agencies and organizations close to the bills are hopeful that these differences will be reconciled and an acceptable bill enacted before the end of the 94th Congress.

ENERGY

Since the Arab oil embargo of 1973, the United States has begun to form a national energy policy. Yet much remains to be done. This section explores important energy developments of the past year that are especially relevant to environmental concerns. A background discussion of energy policy can be found in our 1974 and 1975 Annual Reports and is not repeated here.

In 1975, total U.S. energy consumption dropped by more than 2 percent for the second straight year [256]—a major departure from growth trends of the previous quarter of a century.[257] Petroleum imports, however, rose to about 40 percent of U.S. oil consumption as domestic production continued to fall.[258] The growing dependence on oil imports (see Figure I-5) led to a greater policy emphasis on other domestic energy sources: new provinces for offshore oil and gas, nuclear power, increased use of coal, and new energy technologies. Some of these sources may carry a higher environmental price tag than the readily accessible oil and gas that once were the mainstay of our energy supply, but now are on the decline. The U.S. gross energy consumption for 1947 to 1975 is given in Figure I-6.

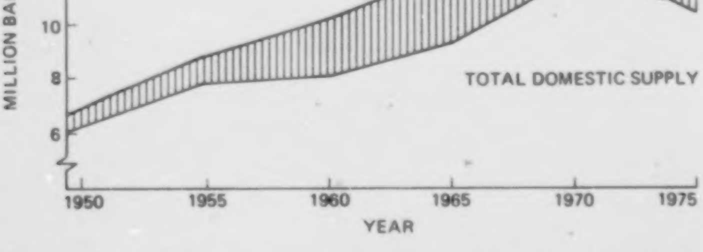


FIGURE I-5. U.S. dependence on imported oil (Source: U.S. Federal Energy Administration)

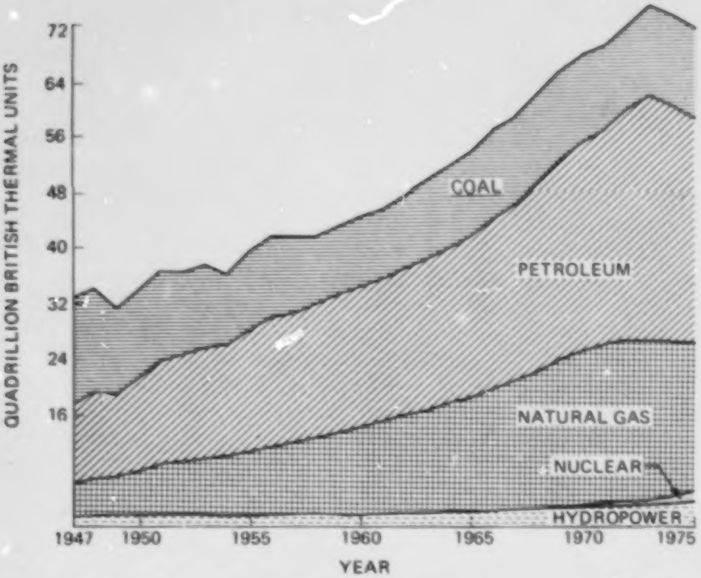


FIGURE I-6. U.S. gross energy consumption by source: 1947-1975 (Source: U.S. Department of the Interior, Bureau of Mines)

ENERGY POLICY AND CONSERVATION ACT OF 1975

The faster we as a nation move toward firm policies of energy conservation, the greater the flexibility we will have in choosing among energy sources, and the less compulsion we will feel to use supplies that unduly stress the environment or risk national security. In late December 1975, with the enactment of the Energy Policy and Conservation Act,[259] Congress and the President finally reached a compromise on an approach to national energy policy, including elements of energy conservation.

The major controversy was over the issue of oil price controls. The President favored deregulation of oil prices as a means both of conserving energy and stimulating oil exploration. Congress favored some sort of price controls. The compromise provision in the 1975 act sets up a complex formula that temporarily rolls back domestic oil prices, permits gradual increases, and allows for termination of controls after 40 months.[260]

In a second section, the act approaches conservation with a three-part package. The principal part of the package involves mandatory fuel economy standards for automobiles beginning with an average of 18 miles per gallon for the 1978 model year and increasing to an average of 27.5 miles per gallon by 1985.[261]

Another part addresses energy efficiency for certain consumer products, such as air conditioners and water heaters.[262] Using tests prescribed by the Federal Energy Administration (FEA), manufacturers must estimate the annual operating costs related to the products' energy consumption.[263] The results must then be displayed in connection with sale of these products. The FEA Administrator must also prescribe voluntary targets for improving energy efficiency for consumer products, and has the discretion to set mandatory energy efficiency standards.[264]

The final part provides assistance for federal, state, and industrial conservation programs. FEA may grant funds and technical assistance to states for preparing and implementing energy conservation plans to achieve a state energy conservation goal of 5 percent or more by 1980.[265] FEA must also set targets for improving energy efficiency in the ten most energy-consumptive industries.[266] Finally, the President is directed by the act to develop mandatory standards for energy conservation and efficiency for federal government facilities and actions.[267]

A third major section of the act deals with domestic supply programs. First, the act extends, until June 30, 1977, FEA's authority to order powerplants and other major fuel-burning installations to convert to coal; it also extends to January 1, 1985, FEA's authority to enforce the coal conversion orders.[268] Our 1975 Annual Report discusses this program in detail; the Air Pollution section in this chapter adds to the discussion.

FEA can guarantee loans for development of underground coal mines,[269] provided that the mine complies with the Federal Coal Mine Health and Safety Act,[270] and the mine operator has a contract for the coal to be burned in compliance with the Clean Air Act.[271] At least 80 percent of the dollar amount of these loans each year must be spent for opening low sulfur coal mines.[272]

Finally, the act provides for a strategic petroleum reserve to store 150 million to 1 billion barrels of petroleum products and crude oil.[273] The initial increment of the reserve, to be created within 3 years, is meant to cushion the impact of any possible supply interruption in regions that depend on imported oil for a considerable portion of their energy.[274]

PROGRESS TOWARD ENERGY CONSERVATION

One of the goals of the new law is to conserve energy supplies by bringing about slower growth in U.S. energy consumption. Even without it there has been a substantial deviation from historical growth trends in the past 2 years. Gross U.S. energy demand, which has risen at about 4 percent a year since 1950, fell by 2.5 percent in 1974, and in 1975 dropped by another 2.5 percent.[275] Similarly, for many years electric power demand grew at an annual rate of about 7 percent.[276] The growth rate for electricity fell to about 1 percent in 1974, and in 1975 was about 2 percent.[275] However, by mid-1976, the demand for both gross energy and electricity increased markedly over 1975 levels.

Major factors contributing to these changes include higher energy prices (as shown in Figure I-7),[277] economic recession, technological/institutional changes, and changes in consumer habits and buying preferences. The relative importance of each of these factors is uncertain and controversial.

The economic, resource, environmental, and national security problems of continued rapid growth in energy consumption have focused attention on the benefits of conservation and increased efficiency. Despite progress in both the private and public sectors, the potential for improvement remains great.

The U.S. Energy Research and Development Administration (ERDA) recognizes greater energy efficiency as a major national goal in its National Plan for Energy Research, Development, and Demonstration (RD&D).[278] Federally funded research on energy conservation per se is a relatively new concept, and programs have had to start from zero or near zero funding. ERDA budget outlays for energy conservation RD&D are estimated at $53 million in fiscal year 1976 compared with $21 million in fiscal year 1975.[279] As shown in Table I-29, ERDA's proposed outlays for 1977 are $88 million.

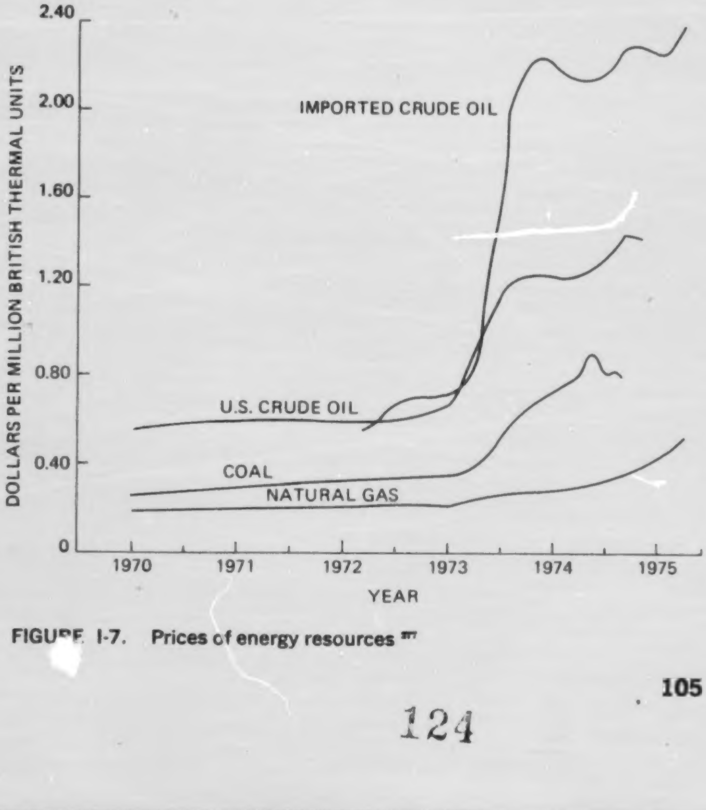
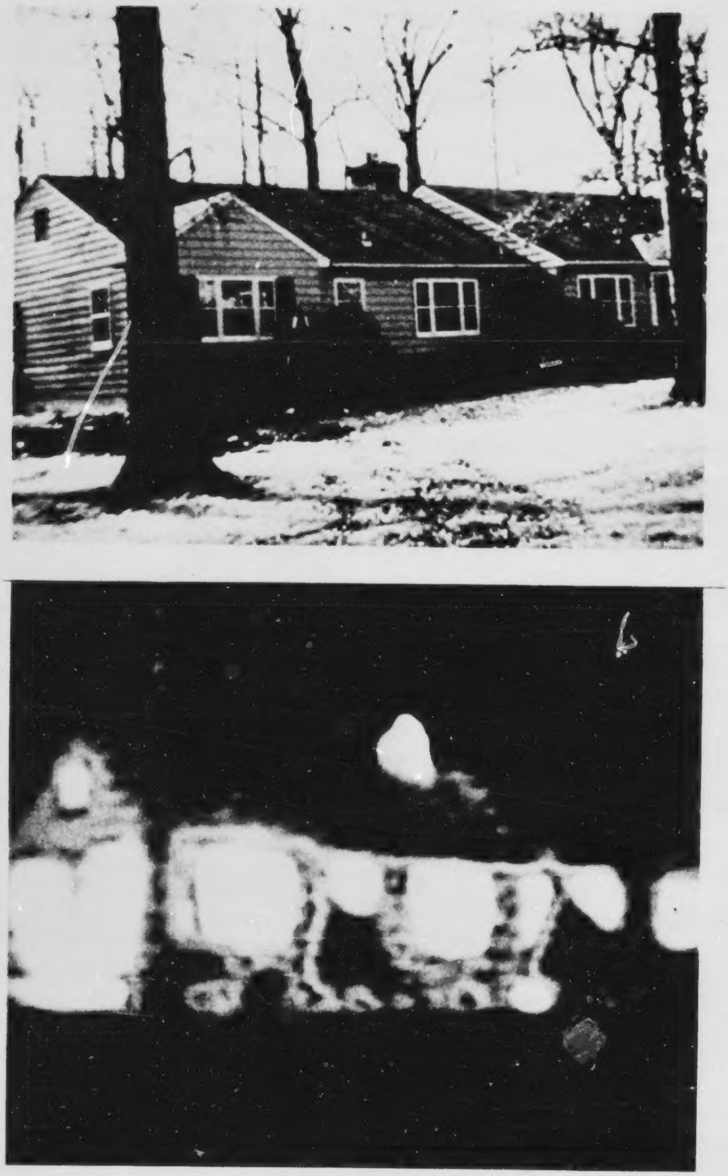


FIGURE I-7. Prices of energy resources [277]

TABLE I-29. ERDA research and development (in millions of dollars)[279]

Programs and groups of programs	Obligations (FY)				Outlays (FY)			
	1975 actual	1976 estimate	Transition quarter estimate	1977 estimate	1975 actual	1976 estimate	Transition quarter estimate	1977 estimate
Conduct of research and development								
Direct nuclear energy research and development								
Fission power reactor and nuclear fuel cycle	466	584	167	921	462	511	140	796
Laser and magnetic fusion	144	197	67	239	132	180	55	225
Subtotal	**610**	**781**	**234**	**1,160**	**594**	**691**	**195**	**1,021**
Direct nonnuclear energy research and development								
Fossil	264	492	97	422	138	327	61	413
Solar	40	111	33	142	15	81	25	111
Geothermal	25	33	12	49	20	31	9	44
Conservation	34	75	16	113	21	53	13	88
Environmental control technology	8	13	4	16	7	11	3	14
Subtotal	**371**	**724**	**162**	**742**	**201**	**503**	**111**	**670**
Supporting energy research and development								
Biomedical and environmental effects	142	175	46	183	135	164	43	175
Basic energy sciences	156	174	49	183	151	167	45	174
Subtotal	**298**	**349**	**95**	**366**	**286**	**331**	**88**	**349**
Nuclear weapons and naval reactors	620	749	212	775	613	702	196	776
Other								
High energy physics	136	153	37	168	132	148	38	163
Nuclear space power and other programs	36	56	16	71	36	48	15	63
Subtotal	**172**	**209**	**53**	**239**	**168**	**196**	**53**	**226**
Total conduct of research and development	**2,071**	**2,812**	**756**	**3,282**	**1,862**	**2,423**	**643**	**3,042**
Total conduct of research, included above	**563**	**694**	**186**	**743**	**509**	**640**	**169**	**707**
Total conduct of development, included above	**1,508**	**2,118**	**570**	**2,539**	**1,353**	**1,783**	**474**	**2,335**
Research and development facilities	**393**	**461**	**66**	**638**	**415**	**418**	**119**	**454**
Total	**2,464**	**3,273**	**822**	**3,920**	**2,277**	**2,841**	**762**	**3,496**



These two photos are of the same house. The bottom photo with the bright white areas around the doors, windows, and chimney is a thermogram indicating excessive heat loss from those areas. Application of such techniques could lead to significant energy savings by identifying poorly insulated areas (Photo credit: National Bureau of Standards)

FEA has continued its broad efforts to stimulate the implementation of efficient energy conservation techniques. As already noted, with the passage of the Energy Policy and Conservation Act, many of FEA's conservation programs were substantially reinforced or expanded with new authorities.

If energy conservation is to achieve its full potential, some fundamental questions still must be answered. In balancing needs for conservation RD&D against efforts to increase supply RD&D, one should remember that, to a large degree, conservation can substitute for expanded supply. For example, a 25-percent improvement in gasoline mileage could have potentially saved 1.3 million barrels of oil per day, which equals about 20 percent of current imports, and is more than double what optimistic estimates suggest the Gulf of Alaska's Outer Continental Shelf (OCS) could produce in 1985.

The conservation option has the advantage of stretching the nation's finite fuel resources and reducing environmental stress. And in many cases, the capital investment required to increase efficiency and save energy is less than the investment needed for an equivalent increase in supply.[280] RD&D for supply is also essential; conservation can trim energy supply requirements only to a certain point. As the American Physical Society's work on energy efficiency shows, however, we are still far from that point.[281] There is considerable opportunity for conservation to substitute for costly, environmentally less desirable supply options, and help to provide time for developing acceptable alternative sources.

During the past year, there has been increasing concern over the degree to which growth in energy use is essential for economic growth. There is evidence that energy growth and economic growth are not inextricably linked. In the United States, from the early 1870's to 1950, the Gross National Product (GNP) per capita rose sixfold, while energy use per capita little more than doubled.[282] Energy efficiency improved rapidly during this period, as indicated in Figure I-8.

ENERGY RESOURCE DEVELOPMENT

Outer Continental Shelf Oil and Gas

The undiscovered oil and gas in unexplored frontier regions of the OCS may prove to be a major new domestic energy source. OCS lands, lying offshore beyond the nearshore water under state control, are federally controlled.[283] Most OCS development so far has been in the Gulf of Mexico, where operating conditions are generally mild and well understood. Development in many new areas will encounter more difficult operating conditions and greater environmental risks. More stringent operating standards will be required. In these areas, a problem requiring particular attention will be the

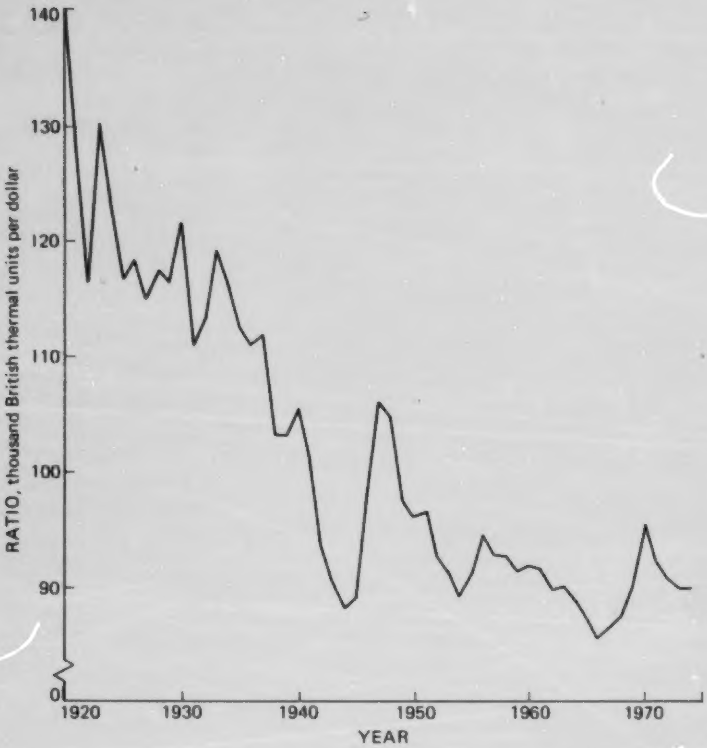


FIGURE I-8. Energy consumption per unit of Gross National Product (Sources: U.S. Department of Commerce, Bureau of Economic Analysis, and U.S. Department of the Interior, Bureau of Mines)

onshore impacts of new support facilities in nearby coastal communities.

During the past year, the U.S. Department of the Interior took several important steps to improve the environmental aspects of the OCS program. Studies relating to the environmental, oceanographic, and geologic considerations were extended to additional frontier regions. In response to suggestions for a pause between the exploration and development phases of offshore operations (at the point where reasonably firm knowledge of the amount and location of oil and gas resources makes it feasible to plan for onshore impacts), the Department established procedures to give states and localities detailed information on the industry's development plans.[284] In addition, the National OCS Advisory Board, composed of representatives of coastal states, federal agencies, and nongovernmental organizations, offers the states a regular means of contributing to the Interior Department's planning and decisionmaking.[285] Regional Advisory Committees, sub-units of the National Board, deal with specific issues in their areas.

In response to coastal state impacts and other concerns, the 94th Congress considered extensive revision of the Outer Continental Shelf Lands Act, the governing legislation for federal offshore oil and gas activities.[285] Both the Senate and the House passed versions of the legislation that would significantly modify leasing procedures, environmental study and assessment requirements, regulatory procedures, and the role of the states.[286]

While these changes were under review, controversy continued over the OCS leasing program. In December, the Interior Department offered for sale some 1.25 million acres of southern California offshore lands in a broad area stretching from near the Mexican border to the Santa Barbara Channel Islands north of Los Angeles. The state of California, along with several city and county governments in the area, opposed the sale and twice attempted unsuccessfully to stop it in court.[287] The court found that Interior's impact statements dealing with acceleration of the OCS leasing program and the southern California lease sale were adequate. Bidding at the sale was lighter than anticipated, and tracts totaling 310,000 acres were finally leased.

The most controversial of sales in frontier areas was that planned for the Northeast Gulf of Alaska in early 1976. The Gulf of Alaska OCS is one of the most environmentally sensitive of the frontier regions, and has some of the worst offshore operating conditions in the world.[288] In December 1975, EPA Administrator Russell Train relayed to CEQ his determination under Section 309 of the Clean Air Act that the sale, as proposed, was environmentally unsatisfactory.[289] After a detailed review of the relevant facts, on January 23, 1976, the Council recommended to the Interior Department that the most environmentally desirable course of action would be to delay the sale for up to 2 years. This delay would allow leasing decisions to be based on better environmental information and would allow more time to plan for onshore impacts.[290] If this recommendation was not acceptable, the Council recommended limiting the sale to approximately 150,000 acres in the northeasternmost, and least environmentally vulnerable, zone of the proposed sale area.

When Secretary of the Interior Kleppe announced his decision to lease 1.1 million acres in a widely dispersed area,[291] the Council informed him that it affirmed Mr. Train's original finding and viewed the action as environmentally unsatisfactory.[292] The Council recognized that the Interior Department had improved the environmental aspects of the OCS program, but in the case of the Gulf of Alaska, judged that additional work was essential to cope with unique, severe conditions.

In an attempt to enjoin the sale, the state of Alaska filed suit in March 1976.[293] Alaska's motion for an injunction was denied. The court pointed out in its findings that the "Secretary [of the Interior] considered the environmental concerns of CEQ, but that he decided to proceed with the lease sale in light of his broader responsibilities to balance the nation's energy needs against potential environmental and socio-economic impacts." The Alaska sale was held on April 13, 1976, resulting in the leasing of about 400,000 acres, less than anticipated by the Interior Department.

The first Atlantic Coast OCS sale also was scheduled for middle to late 1976.

Coal Leasing

About half of the nation's coal reserves lie in the West under direct control of the federal government. Federal government policies in making this coal available will therefore be a critical factor in national and regional supply patterns. With more than 20 billion tons of the publicly controlled coal reserve already leased or otherwise committed to private ownership, a virtual moratorium on extensive new leasing has been in effect since 1971, pending a full-scale review of leasing policy.[294]

In January 1976, the Interior Department announced the components of the new coal-leasing program that has been under development for 4 years.[295] Seeking to eliminate some major problems of the past, Interior will make coal available only through competitive bidding, rather than through issuing first-come, first-served prospecting permits to all qualified parties. It will also impose requirements to ensure that existing leases are diligently developed in a timely manner and not held indefinitely with no effort to produce the coal, as is now often the case.

The Interior Department will use two principal vehicles for environmental protection. Because most of the federal coal will be strip mined, new surface mining regulations establish much stricter standards than existed previously for federal lands. The Interior Department's enforcement record has been spotty in the past, however, and successful reclamation will depend upon vigilant enforcement of the new rules. The regulations provide for enforcement of state laws in cases where they are more stringent than the proposed federal regulations. In addition, before leasing new coal, the Department intends to rely on land use plans and regional environmental impact statements for the sale area. No leases will be issued where reclamation of the lands is impossible.

Major Environmental Issues of New Energy Systems and Facilities

Expansion of domestic coal production, shifts to new sources of petroleum, and construction of large, new energy facilities of all types have raised major unresolved environmental issues.

Expanded OCS production, shipment of Alaskan oil by tanker, and increasing oil imports signify growing risks of oil pollution. Two steps taken during the past year have tightened controls on oil operations. The U.S. Coast Guard released regulations requiring segregated ballast on new oil tankers under the U.S. flag.[296] Segregating the ballast tanks from the oil tanks not only limits routine oil discharges, but also tends to reduce the chances of a major oil spill in case of accident. Another improvement is that the Interior Department has tightened the operating orders for protection of the environment and human safety for OCS oil and gas operations.[297]

An important national problem identified by the Administration is ensuring full and equitable compensation to those suffering damages from oil pollution. Presently, according to a 1975 interagency study coordinated by the U.S. Department of Justice, widely varying state and federal laws may make it difficult or even impossible for victims to recover oil pollution damages.[298] The Administration submitted a bill in July 1975 to establish a comprehensive system of strict liability for virtually all provable oil pollution damages.[299] Claims could be established administratively without necessitating time in court; a permanent fund based on an oil fee would ensure full compensation, even when the polluter could not be identified or was unable to pay all claims. This bill and similar legislation are under active consideration by the 94th Congress.

Drilling for oil in new offshore provinces and opening of extensive new coal mines in the West means that these regions, most of them inexperienced with energy activities, will face large-scale impacts from new facilities, rapidly growing population, and extra demands for government services. Many government units in the regions affected, particularly at the local level, lack the resources to plan for this growth and to provide the necessary services. As most of the impacts will stem directly from federal decisions to develop publicly owned resources, there is general recognition of a federal obligation to provide impact assistance to states and localities where needed. The Land Use section of this chapter contains a discussion of some of these proposals.

The social and economic impacts of rapid growth are common to many types of energy developments, including refineries and petrochemical complexes, offshore oil platform construction yards, coal mines and gasification plants, and large powerplants. Similar problems are expected to arise at most of them, and many times the solutions found for one will apply to another.

Impacts on the natural environment vary much more widely from one facility and one system to the next. Nonetheless, some common classes of problems are emerging. Impacts on air quality, for example, may fall into one of two classes that make resolution difficult: first, degradation of air quality in pristine areas, and second, potential additions to pollution in places where air quality presently fails to meet national standards.

An example of the second problem arose in Portsmouth, Virginia, near Norfolk, where plans for a new 175,000-barrel-per-day refinery were questioned by EPA because current ozone levels in the metropolitan area exceed the primary standard. Although the design for the new refinery meets EPA's new source standards, any additional emissions of pollutants from a new plant would "only worsen the air quality," which is presently in violation of the standards, according to an EPA spokesman.[300]

In amending the Clean Air Act, Congress is giving attention to the problems of energy and other industrial development in so-called nonattainment areas, as discussed in the Air Pollution section of this chapter. The 1976 Clean Air Act Amendments also address the issue of preserving clean air in areas that are little touched by pollution. The proposed Kaiparowits plant, a 3,000-megawatt coal-fired powerplant slated for undeveloped southern Utah, posed this problem and several others common to new energy facilities.

Thirteen-year-old plans for development of the Kaiparowits plateau underground coal mine and powerplant were suspended indefinitely by Southern California Edison and San Diego Gas and Electric Company on April 14, 1976. Impacts expected from the generation of electricity were serious: air quality would have been degraded in an area that depends on long, clear vistas for an appreciation of formations such as those found in Bryce Canyon, Capitol Reef, and Grand Canyon National Parks; 16,000 persons would have moved into a sparsely populated area, requiring a new town and numerous services; and 50,000 acre-feet of water per year would have been removed from Lake Powell in the Glen Canyon National Recreation Area, which would increase salinity in the salinity-prone lower Colorado River basin. Additionally, many secondary impacts were expected, such as increased visitor use of the nearby parks. (More than one-fifth of all National Park acreage is within 200 miles of the proposed Kaiparowits site, as shown in Figure I-9.)[301]

Natural Gas

Selection of a system for delivering natural gas from Alaska's North Slope to the lower 48 states is the subject of current hearings before the Federal Power Commission (FPC).[302] Two principal transportation routes have been proposed; these are shown in Figures I-10 and I-11. One proposal is to build a 5,551-mile pipeline from Prudhoe Bay through Canada's MacKenzie River Valley to the U.S. Midwest (Figure I-10); the other is to construct a second pipeline for gas beside the Trans-Alaska Pipeline for oil, liquefy the gas at a terminal in the Gulf of Alaska, and ship it in liquefied natural gas (LNG) tankers to a California terminal (Figure I-11). Environmental impact statements on these two proposals have been prepared by the FPC and the Interior Department. A third proposal is being developed to follow the Trans-Alaska Pipeline as far as Fairbanks, then parallel the Alcan Highway and tie into a proposed Canadian nat-

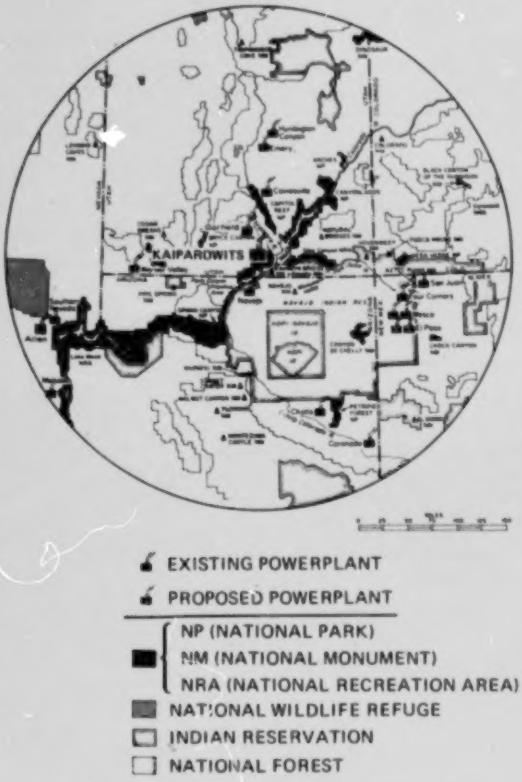

KAIPAROWITS
EXISTING POWERPLANT
PROPOSED POWERPLANT
NP (NATIONAL PARK)
NM (NATIONAL MONUMENT)
NRA (NATIONAL RECREATION AREA)
NATIONAL WILDLIFE REFUGE
INDIAN RESERVATION
NATIONAL FOREST

FIGURE I-9. Site of the proposed Kaiparowits project, a 3,000-megawatt coal-fired powerplant (Source: Environmental Defense Fund)

ural gas line from the Mackenzie Delta. As an alternative route through Canada, this would avoid crossing the Arctic National Wildlife Range, one of the world's most magnificent wilderness areas.

President Ford, in his February 26 Energy Message proposed legislation that would require the FPC to complete its hearings and send a recommendation to the President by January 1, 1977.[303] It would also direct other federal agencies to complete their environmental, economic, and resource assessments of the alternate systems by February 1, 1977, and would then permit the President to select the route, subject to review by Congress. If Congress did not disapprove the selection, judicial review thereafter would be limited, following the precedent of the Trans-Alaska Pipeline Act of 1973.

The gas resource in Alaska seems to be substantial; delivery of 1 trillion cubic feet of gas per year (almost 5 percent of U.S. consumption in 1975) could possibly occur in the 1980's.[304] The environ-

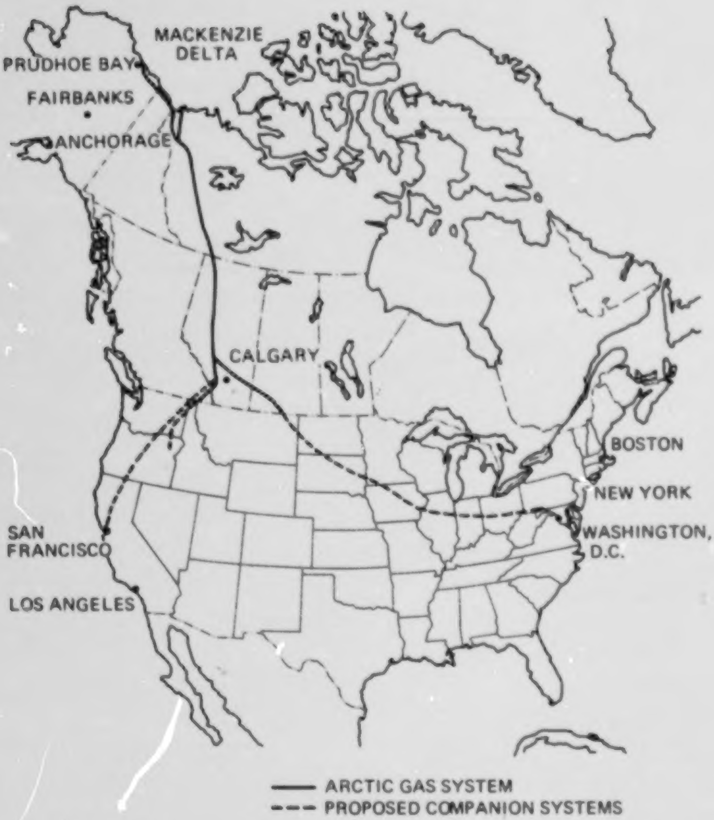

PRUDHOE BAY
MACKENZIE DELTA
FAIRBANKS
ANCHORAGE
CALGARY
BOSTON
NEW YORK
WASHINGTON, D.C.
SAN FRANCISCO
LOS ANGELES
ARCTIC GAS SYSTEM
PROPOSED COMPANION SYSTEMS

FIGURE I-10. **Proposed Arctic gas system (Source: U.S. Federal Energy Administration)**

mental issues for the Trans-Canada routes center around disturbances of untouched permafrost, tundra, and wildlife habitat. The other route, which follows in the tracks of the Trans-Alaska Pipeline, depends upon large-scale liquefaction of gas, and raises issues of LNG safety, especially in the siting of terminals.

The risk of a serious LNG accident is considered very low with the present design of facilities and the safety measures now in effect, but the danger of a serious fire cannot be entirely eliminated.[305] A terminal in a developed harbor would tend to have a minimum impact on the natural environment, but would pose greater risk to human safety in case of accident. Conversely, a remote site would have a greater effect on natural ecosystems and may induce undesirable development in a rural area, but would expose the fewest persons to danger.

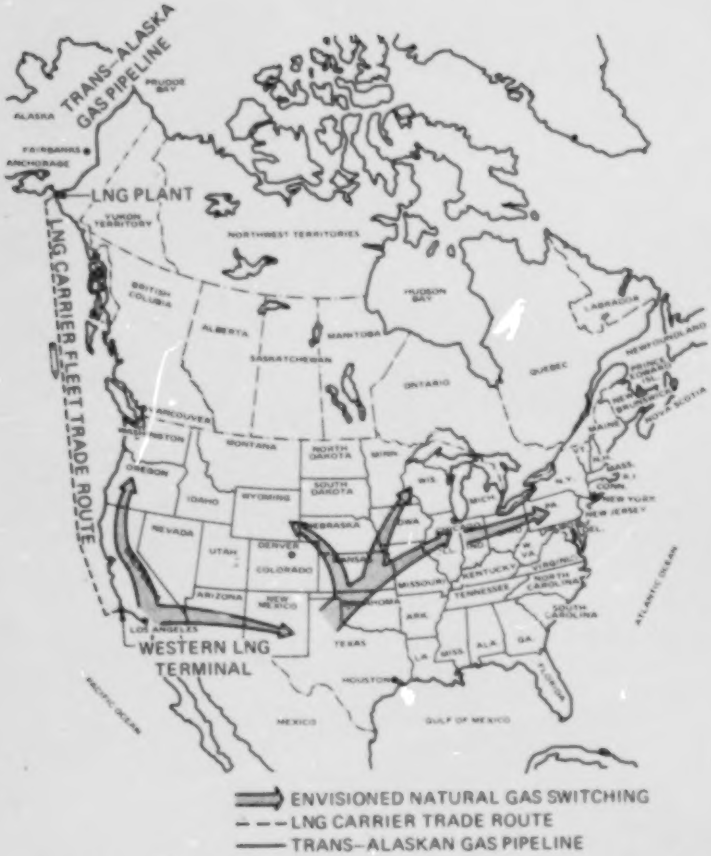

TRANS-ALASKA GAS PIPELINE
PRUDHOE BAY
ALASKA
FAIRBANKS
ANCHORAGE
LNG PLANT
YUKON TERRITORY
NORTHWEST TERRITORIES
LNG CARRIER FLEET TRADE ROUTE
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
HUDSON BAY
LABRADOR
NEWFOUNDLAND
QUEBEC
ONTARIO
PRINCE EDWARD ISL.
NEW BRUNSWICK
NOVA SCOTIA
VANCOUVER
WASHINGTON
OREGON
IDAHO
MONTANA
WYOMING
NORTH DAKOTA
SOUTH DAKOTA
MINN.
WIS.
MICH.
MAINE
VT.
N.H.
MASS.
R.I.
CONN.
N.Y.
PA.
NEW YORK
NEW JERSEY
DEL.
NEVADA
UTAH
DENVER
COLORADO
NEBRASKA
KANSAS
IOWA
ILL.
IND.
OHIO
W. VA.
VIRGINIA
KENTUCKY
MISSOURI
NORTH CAROLINA
TENNESSEE
SOUTH CAROLINA
ARIZONA
NEW MEXICO
OKLAHOMA
ARK.
LOS ANGELES
WESTERN LNG TERMINAL
TEXAS
LA.
MISS.
ALA.
GA.
FLORIDA
HOUSTON
ATLANTIC OCEAN
PACIFIC OCEAN
MEXICO
GULF OF MEXICO
ENVISIONED NATURAL GAS SWITCHING
LNG CARRIER TRADE ROUTE
TRANS-ALASKAN GAS PIPELINE

FIGURE I-11. **Proposed El Paso system (Source: U.S. Federal Energy Administration)**

ENERGY TECHNOLOGY DEVELOPMENT

Synthetic Fuels

In February 1976, the Administration again supported enactment of authorities to guarantee at least 350,000 barrels per day of synthetic fuel production by 1985. The proposed synthetic fuels program would provide $2 billion of assistance to commercial facilities for synthetic gas, coal liquefaction, and shale oil, which are not now proven to be economically competitive. A draft environmental impact statement on the synthetic fuels commercialization program has been issued, and an environmental protection strategy has been outlined for the synthetic fuels program.

In addition, ERDA has several coal conversion pilot plants currently in operation; several demonstration plants are also being developed. A contract for a boiler fuel demonstration plant (COALCON) has been let, and the plant is being designed. Additional contracts, for high-Btu and low-Btu demonstration plants, are being initiated. The 1975-1977 budgets for ERDA's Fossil Energy Research and Development Programs are shown in Table I-29.

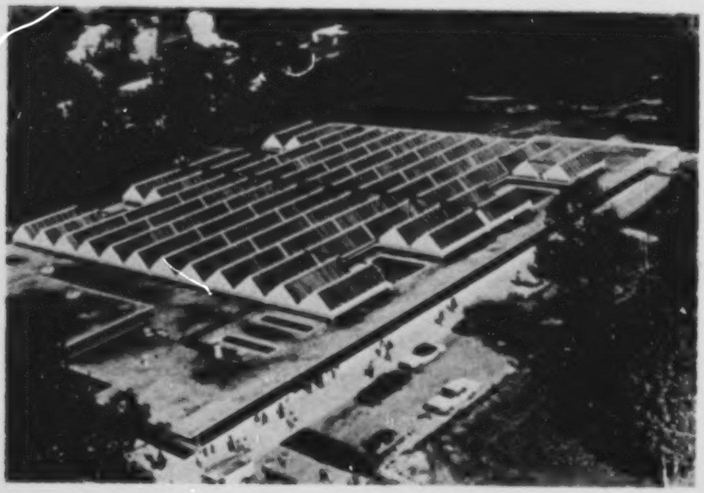
Solar Energy

Enormous amounts of energy are potentially available from the sun. If RD&D programs are successful, solar energy could provide a large fraction of our energy needs within a few decades. One 1975 estimate made by ERDA suggests that by the year 2020, solar energy could supply 25 percent of the total U.S. energy demand.[306] Others suggest values that are considerably higher or lower.

Solar energy RD&D is still at a relatively primitive stage, but development is active; new systems are continually being invented and tested.

Much of the effort in the private sector has been directed toward the development of heating systems for houses. By the beginning of 1976, more than 200 houses were using solar heating systems.[307]

The President's proposed budget for FY 1977 included $111 million for solar RD&D, an increase of 37 percent over the $81 million of



Increasing numbers of homes and buildings are being heated and cooled by solar energy. This elementary school in Atlanta, Georgia, is the largest heating and cooling solar energy system ever undertaken as of 1975 (Photo credit: Westinghouse) funding for FY 1976; the budget was $15 million in FY 1975 (see Table I-29).

ERDA has developed a National Solar Energy RD&D Program to complement the efforts of the private sector.[306] The program will include Direct Thermal Applications, Solar Electric Conversion, and Fuels from Biomass.

The *Direct Thermal Applications* subprogram comprises two major units: solar heating and cooling for buildings and hot water supply, and the use of solar heat for agriculture and for industrial processes. Possible agricultural applications include food dehydration and crop drying, lumber drying, heating and cooling greenhouses, and heating animal shelters. Low-cost highly reliable components will have to be developed in order to have a sizable impact on national energy needs. Some important institutional problems remain to be solved. Local building codes, for example, may restrict the use of solar systems; the lack of a legal basis for sun rights could also deter property owners in some locations.

The *Solar Electric Applications* subprogram will include RD&D on the generation of electricity from windmills, solar (photovoltaic) cells, solar thermal-electric systems, and ocean thermal-energy conversion. The way in which these systems would work is reasonably well understood in practice. Making them economically feasible is the chief stumbling block. A solar thermal-electric powerplant would be similar in some ways to today's fossil or nuclear powerplants, but instead of obtaining thermal energy from burning fossil fuels or splitting atoms, it would use solar energy. One possible design is shown in Figure I-12.[308] An ocean thermal-energy powerplant would use temperature differences to drive a turbine.[308]

The *Fuels from Biomass* subprogram will examine the feasibility of the large-scale use of organic materials to provide energy. Biomass means such organic materials as animal manure, field crops and crop wastes, forest crops and wastes, and marine plants and animals. Many biomass conversion processes are known to be technically feasible, and some have been widely demonstrated. In 1850, about 90 percent of U.S. energy needs were met by the direct use of fuel wood. During World War II, much of France's liquid fuel supply consisted of methanol produced from wood. At the present time in the United States, however, very little useful energy is generated from such sources. An ERDA report suggests that, by the turn of the century, fuels from biomass could supply an energy equivalent of 1.5 million barrels of oil per day.[306] Processes to be examined include fermentation to produce methane and alcohol, chemical processes to produce methanol, and pyrolysis to convert organic waste material to low-Btu gaseous fuels and oils.

Nuclear Energy

Nuclear Power. Most of the difficulties that involved nuclear power in 1974 and in 1975 are still present in 1976. The entire elec-

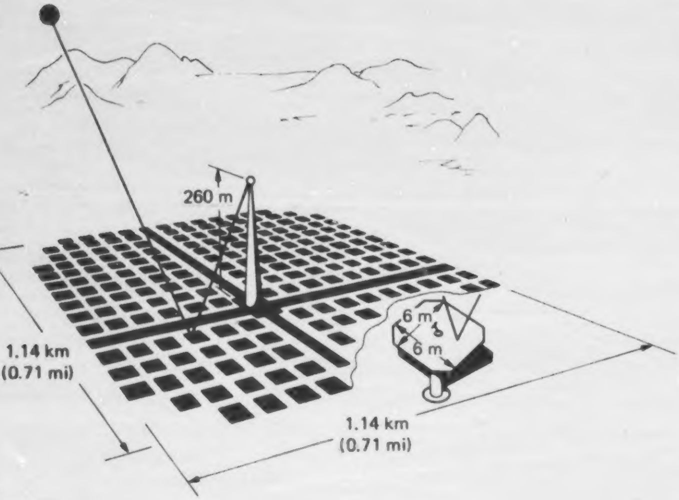


FIGURE I-12. Solar-thermal conversion by modular central receiver concept.[308] A 100-megawatt baseloaded electric plant would require three modules. Solar energy is transmitted optically from collectors mounted on two-directional tracking systems to a tower-top receiver (or boiler) near the turbogenerator

tric utility industry experienced slower load growth than anticipated, financing was difficult, and construction delays were common. As of January 31, 1976, of the 68 powerplants granted construction permits, 53 have been delayed. Similarly, 23 of 38 reactors on order or publicly announced have been delayed, and of 73 reactors currently under review by the Nuclear Regulatory Commission (NRC), 49 have been delayed.[309] Fifty-eight nuclear power generating units capable of generating nearly 40,000 megawatts were licensed by the NRC to operate in the United States by May 1976.[310]

After considerable controversy, in December Congress passed a 10-year extension of the Price-Anderson Act, providing government indemnity for liability of nuclear powerplants in case of accidents.[311] Debate continued on legislation to permit private industry to build uranium enrichment plants. The federal government owns and operates all three existing uranium enrichment plants, which are located at Oak Ridge, Tennessee; Portsmouth, Ohio; and Paducah, Kentucky. A bill proposed by the Administration would provide government support for private firms wishing to enter the enrichment business.[312]

In November the NRC announced its schedule and procedures for completing the environmental impact statement, and its decision on whether to permit recycling of plutonium.[313] However, on May 26, 1976, in a suit brought by five environmental groups and the state of New York, the U.S. Court of Appeals for the Second Circuit, after a review, reversed and remanded to the commission the portion of the order dealing with interim licensing of plutonium recycle facilities prior to the commission's final decision on wide-scale use of plutonium.[314] Recycling of plutonium consists of separating the plutonium that is formed as uranium is burned in the reactor, and recycling it as fresh fuel in other reactors. The separation step, which also removes the waste fission products and unused uranium, would be accomplished in a reprocessing plant. Ranged against the advantage of reusing plutonium as fuel instead of treating it as waste are its dangers as a highly toxic material and its potential use as a nuclear explosive. If not adequately safeguarded, plutonium that has been diverted or stolen from a nuclear fuel cycle could be used to make an illicit nuclear weapon. Because of its extreme toxicity when ingested or inhaled, accidental release of plutonium is also a danger. A commission decision is likely in 1977. (For a more detailed review of plutonium recycle and the nuclear fuel cycle, see our Sixth Annual Report.)

On January 19, 1976, the NRC sent to Congress and to CEQ its report on the feasibility and practicality of locating nuclear power reactors and other elements of the nuclear fuel cycle on nuclear energy center sites.[315] The report concluded that, depending on the location, it can be feasible and practical to construct up to about 20 nuclear reactors on a single site; however, no great or compelling need for such a center was identified.

Public acceptance of nuclear power continues to be a major issue. By August 1975, no fewer than 28 states were considering antinuclear initiatives of some kind.[316] These proposals reflected a wide range of public concerns about nuclear power, but most had in common concerns about radioactive waste disposal and plant safety and security.

In June 1976, the California Initiative, which would have restrained nuclear powerplant construction and operation until satisfactory safety and waste disposal methods had been demonstrated, was defeated by a 2 to 1 margin. However, before the election, the California legislature passed three bills which will prohibit further nuclear powerplant expansion in the state until questions regarding radioactive waste disposal and reprocessing technologies have been answered and a study is made of underground siting of nuclear reactors.[317] Similar legislation will be voted on in the November elections in Colorado, Oregon, and Washington.

Liquid Metal Fast Breeder Reactor (LMFBR). After the most extensive environmental review yet conducted for a major energy technology, the ERDA Administrator has decided to continue LMFBR development at its present pace through demonstration of the first breeder prototype in the early 1980's.

The breeder reactor is capable of producing more useful nuclear fuel than it consumes, thus extending limited supplies of uranium, possibly for centuries. As it "burns" plutonium to generate electric power, the LMFBR converts a blanket of natural uranium around the fuel core into still larger quantities of fissionable plutonium. However, serious environmental concerns have been raised in connection with the breeder: first, risks in handling large quantities of plutonium throughout the fuel cycle; and second, the special safety problems that arise from the use of highly reactive sodium as a coolant. Questions of costs and benefits were also raised during the NEPA review of the LMFBR program.[318]

ERDA plans to build and test a series of increasingly larger breeders, beginning with a 350-megawatt demonstration plant in Tennessee, to show whether large breeder reactors are safe and economical. After the prototype is tested, ERDA will conduct another environmental review before reaching a decision on whether to permit eventual commercial deployment.

The NRC, which must license the plant, issued in February 1976 a draft environmental impact statement for ERDA's Clinch River Breeder Reactor demonstration plant to be constructed in Tennessee.[319]

Radioactive Wastes. Federal efforts to find suitable storage and disposal methods for radioactive wastes, from both nuclear weapons development and from the commercial nuclear power industry, intensified during the past year. Radioactive wastes, which are created as uranium fissions and releases energy in nuclear reactors, are a significant potential environmental hazard. They must be isolated from the biosphere for hundreds of thousands of years. The wastes contain both highly radioactive but "shorter lived" wastes, with half-lives of tens to hundreds of years, and less radioactive but longer-lived species, such as plutonium, which has a half-life of about 25,000 years. The half-life of a radioactive element is the time required for a given quantity of the element to decay or disintegrate into one-half of the original quantity. Isolated storage over many half-lives is necessary before most wastes become harmless.

The lack of permanent, safe storage or disposal for high-level radioactive wastes from nuclear reactors has become a major concern in recent years. Radioactive wastes are now temporarily stored in tanks at commercial and government nuclear facilities. Large quantities of radioactive wastes from nuclear weapons production are stored in tanks and bins at government installations in Idaho, South Carolina, and Washington.

To help clarify waste management issues and to identify appropriate responsibilities at the federal government level, an Interagency Task Force on Commercial Nuclear Wastes has been established. Chaired by the Office of Management and Budget (OMB) the task force consists of representatives of EPA, ERDA, NRC, and CEQ. An independent assessment of waste management practices at ERDA's Hanford Reservation was undertaken by the National Academy of Sciences under the sponsorship of ERDA and CEQ. The study, which was long sought by environmental groups, will examine the safety and environmental acceptability of past waste management practices at the Hanford facility and will recommend future practices.

In July 1976, representatives from many countries met at an ERDA-sponsored international symposium in Denver, Colorado, to exchange information on alternative methods of nuclear waste storage and disposal, such as isolation in deep geologic formations like salt beds and granite, or below the sea floor. Other waste disposal methods, including transmutation into less hazardous materials, were also discussed.

Nuclear Export. U.S. nuclear export activities, including power reactors and fuel, continued to be an issue and were the subjects of hearings by a Senate Committee on Government Operations in early 1976. The issue is the relationship between the global spread of civilian nuclear powerplants and the uranium and plutonium that fuels them, and the spread of nuclear weapons capability inherent in the technology.

One possible approach to control the proliferation of nuclear technology is through international agreements such as the Non-Proliferation Treaty and through organizations such as the International Atomic Energy Agency (IAEA). In early 1976, a group of nuclear supplier nations including Canada, France, Germany, Japan, Soviet Union, United Kingdom, and the United States, reached a limited agreement requiring that strategic nuclear weapons material produced by the technologies which those countries export be placed under IAEA safeguard measures.[320] However, much stronger international agreements and measures will be needed to ensure that nations or terrorist groups do not turn the products of peaceful nuclear power into atomic weapons. In an action urged by the United States and intended to lessen the danger of proliferation, South Korea agreed in February not to purchase a nuclear fuel reprocessing plant from France.[321]

In April, ERDA issued its final environmental impact statement on U.S. nuclear export activities.[321] This issue will probably receive even more attention in the coming year.

ENVIRONMENTAL IMPACT STATEMENT PROCESS

EVENTS AMONG FEDERAL AGENCIES

The environmental impact statement process needs improvements, but its basically sound structure has strengthened federal agency planning and decisionmaking. This was the primary conclusion of our comprehensive 1976 report on the impact statement requirements of the National Environmental Policy Act (NEPA).[322]

The improvement most critically needed is to make the impact statement process more useful to, and more a part of, agency planning and decisionmaking. Our report recommended new steps to make impact statements more analytical in content and manageable in size. Some agencies have already begun to take these steps.

Whether or not the impact statement requirement causes crippling red tape and needless delays in federal efforts to boost the economy was very much a concern of agency administrators during the recession year of 1975. Our report concluded that there were substantial problems of delay in the early years of NEPA, but that they are diminishing as agencies improve their environmental expertise and begin impact statement preparation earlier in their planning and decisionmaking process. The trend toward shorter times for preparation of draft and final environmental impact statements continued in 1975.

Over the past 6 years, court action has contributed toward agencies' taking the process seriously in their planning and decisionmaking, but major unnecessary delays in federal actions have been ascribed to litigation on NEPA issues.

Our survey of agency experience on NEPA litigation helps put the litigation/delay issue in perspective. The survey shows that in 5½ years from January 1, 1970, to June 30, 1975, there were 654 cases completed or pending in which a NEPA issue was alleged by an environmental, business, labor, or other party to the litigation. Of these 654 cases, 363 were brought on the ground that an impact statement was required. This litigation record contrasts with the tens of thousands of federal administrative actions taken in the same period. (More than 30,000 actions were assessed by federal agencies in FY 1975 alone to determine whether they would cause significant environmental effects.) Most of the other 291 cases challenged the adequacy of an impact statement that had been prepared. This figure contrasts with the 6,000 impact statements that were prepared during the same period; at most, approximately 5 percent of the actions was challenged in court.

Table I-30 shows that 332 cases were completed by June 30, 1975, with about one-third of the cases dismissed at the trial court level. The ultimate disposition of the remaining cases often took several years, although agency action would be legally delayed only because of an injunction. Of all the cases completed, no more than 60 resulted in temporary injunctions, which ranged from a few weeks to the time required to prepare an adequate impact statement. Only four resulted in "permanent" injunctions, although in no case was the agency precluded from proceeding with its project or program after it complied with NEPA.

The agencies most affected by NEPA litigation have been the U.S. Departments of Transportation (26 percent of the cases), Housing and Urban Development (14 percent), and Agriculture, and the Army Corps of Engineers (about 10 percent each).

TABLE I-30. NEPA-related cases completed as of June 30, 1975 [332]

U.S. agency	Total cases	Number of impact statements alleged	Dismissed by trial court	Dismissed where no impact statement alleged	Dismissed where inadequate impact statement alleged	Injunctions where no impact statement alleged	Injunctions where inadequate impact statement alleged	Total permanent injunctions
Agriculture	31	23 (74)	10 (33)	8 (26)	1 (3)	4	1	0
Commerce	4	3 (75)	2 (50)	1 (0)	0 (0)	0	0	0
Consumer Product Safety Commission	1	1 (100)	0 (0)	0 (0)	0 (0)	0	0	0
Air Force	1	0 (0)	0 (0)	0 (0)	0 (0)	0	0	0
Army Corps of Engineers	34	15 (44)	1 (3)	1 (3)	0 (0)	3	5	2
Navy	11	9 (82)	10 (91)	8 (73)	2 (18)	0	0	0
Environmental Protection Agency	12	6 (50)	2 (17)	1 (9)	1 (9)	1	2	0
Federal Communications Commission	1	0 (0)	0 (0)	0 (0)	0 (0)	0	0	0
Federal Energy Administration	2	2 (100)	0 (0)	0 (0)	0 (0)	0	0	0
Federal Power Commission	10	7 (70)	0 (0)	0 (0)	0 (0)	0	0	0
General Services Administration	6	4 (71)	1 (14)	1 (14)	0 (0)	0	0	0
Health, Education, and Welfare	5	3 (60)	2 (40)	1 (20)	1 (20)	1	0	0
Housing and Urban Development	46	32 (70)	22 (48)	17 (37)	5 (11)	6	1	0
Interstate Commerce Commission	7	3 (43)	0 (0)	0 (0)	0 (0)	0	1	0
Interior	22	10 (45)	3 (14)	1 (5)	2 (9)	0	3	0
Justice	6	5 (84)	4 (67)	350)	1 (17)	1	0	0
National Aeronautics and Space Administration	1	1 (100)	0 (0)	0 (0)	0 (0)	0	0	0
National Capital Planning Commission	8	7 (88)	1 (13)	1 (13)	0 (0)	2	0	0
Nuclear Regulatory Commission	17	4 (23)	5 (29)	1 (6)	2 (12)	1	0	0
Securities and Exchange Commission	4	0 (0)	3 (75)	0 (0)	0 (0)	0	0	0
Transportation	88	49 (56)	38 (43)	20 (23)	16 (18)	8	9	1
Treasury	7	6 (86)	3 (43)	3 (43)	0 (0)	0	0	1
Tennessee Valley Authority	5	2 (20)	0 (0)	0 (0)	0 (0)	0	1	0
Water Resources Council	3	1 (33)	2 (67)	1 (33)	1 (33)	0	0	0
Total	332	193 (58)	109 (33)	68 (20)	32 (9)	27 •	23 •	4 •

• Other NEPA-related "injunctions": 10; other non-NEPA-related injunctions: 1.

Note: Numbers in parentheses denote percentage of the total number of cases.

As of June 30, 1975 (see Table I-31), 322 cases were still pending. As would be expected, the number of cases in which the plaintiff said that there was no environmental impact statement and that one was required declined by 5 percent. Less than one-fourth of the cases was dismissed, although it is still too early to determine whether there will be an overall decline in dismissals; such analysis may be made after information is received on cases completed as of June 30, 1976. To date, however, the number of cases and proportion of cases incurring temporary injunctions have remained about the same as for completed cases. Of the 322 pending cases, 63 have resulted in temporary injunctions—a 2-percent increase over the completed cases—and only two have resulted in "permanent" injunctions, which did not prevent agency action after full NEPA compliance.

The distribution of pending litigation among the agencies has also remained fairly constant, with one notable exception. The U.S. Department of Transportation still had the highest proportion, with 21 percent of the cases, but the Department of the Interior was a close second with 19 percent. Housing and Urban Development had 15 percent, and the Department of Agriculture and the Corps of Engineers had about 9 percent each.

We will examine litigation experiences in the coming year for trends in the types of NEPA issues alleged, agency actions challenged, and court dispositions made.

Environmental impact statement procedures became increasingly routine and effective parts of planning and decisionmaking in the past year. As Table I-32 [322] shows, more than 70 federal departments and agencies had such procedures as of April 1976.

Table I-33 shows that the number of draft impact statements filed in 1975 decreased slightly over the previous several years. It is expected, however, that the number will increase somewhat in 1976 as the scope of the process continues to expand. Long-established agencies continue to broaden the application of the impact statement requirement, and new agencies, such as FEA and CPSC are adopting the process to their decisions.

Program impact statements continue to be used as a means of analyzing impacts of major programs and their alternatives. As of March 1976, 24 of the 33 departments and major agencies had used program statements (see Table I-34). In 1975 we received final impact statements on 38 broad federal programs, covering a range of topics. Examples are the Emergency Watershed Protection Program of the Soil Conservation Service, the National Wildlife Refuge Program of the Fish and Wildlife Service of the Interior Department, the Coal Conversion Program of the Federal Energy Administration, and the Renewable Resources Program of the Forest Service. This increased use of program statements contrasts, however, with the fact that only 17 agencies have adopted program impact statement procedures. Our environmental impact statement report notes that improved guidelines are needed on this subject.

TABLE I-31. NEPA-related cases pending as of June 30, 1975 [33]

U.S. agency	Total cases	Number of impact statements alleged	Dismissed by trial court	Dismissed where no impact statement alleged	Dismissed where inadequate impact statement alleged	Injunctions where no impact statement alleged	Injunctions where inadequate impact statement alleged	Total permanent injunctions
Agriculture	30	23 (74)	10 (33)	8 (26)	1 (3)	4	1	0
Civil Aeronautics Board	2	2 (100)	0 (0)	0 (0)	0 (0)	0	0	0
Commerce	1	0 (0)	0 (0)	0 (0)	0 (0)	0	0	0
Consumer Product Safety Commission	2	2 (100)	(0)	0 (0)	0 (0)	0	0	0
Air Force	3	2 (50)	0 (0)	0 (0)	0 (0)	1	0	0
Corps of Engineers	29	2 (7)	0 (0)	0 (0)	0 (0)	2	14	2
Army	2	1 (50)	0 (0)	0 (0)	0 (0)	0	0	0
Navy	3	2 (67)	0 (0)	0 (0)	0 (0)	2	0	0
Environmental Protection Agency	12	8 (75)	0 (0)	0 (0)	0 (0)	1	0	0
Energy Research and Development Administration	4	4 (100)	0 (0)	0 (0)	0 (0)	0	0	0
Federal Communications Commission	1	0 (0)	0 (0)	0 (0)	0 (0)	0	0	0

Federal Energy Administration	2	2 (100)	0 (0)	0 (0)	0 (0)	0	0	0
Federal Power Commission	3	1 (33)	1 (33)	0 (0)	1 (33)	0	0	0
Federal Trade Commission	3	3 (100)	0 (0)	0 (0)	0 (0)	0	0	0
General Services Administration	9	5 (56)	3 (33)	2 (22)	0 (0)	2	0	0
Health, Education, and Welfare	6	5 (83)	1 (17)	0 (0)	0 (0)	0	0	0
Housing and Urban Development	48	35 (73)	2 (4)	2 (4)	0 (0)	8	0	0
Interstate Commerce Commission	2	1 (50)	0 (0)	0 (0)	0 (0)	0	1	0
Interior	16	21 (34)	0 (0)	0 (0)	0 (0)	1	1	0
National Capital Planning Commission	1	1 (100)	0 (0)	0 (0)	0 (0)	0	0	0
Nuclear Regulatory Commission	10	2 (20)	0 (0)	0 (0)	0 (0)	0	0	0
Office of Management and Budget	1	0 (0)	0 (0)	0 (0)	0 (0)	0		
State	3	3 (100)	0 (0)	0 (0)	0 (0)	0	0	0
Transportation	69	31 (45)	5 (7)	1 (1)	2 (3)	7	10	0
Treasury	4	4 (100)	0 (0)	0 (0)	0 (0)	0	0	0
Tennessee Valley Authority	11	10 (91)	0 (0)	0 (0)	0 (0)	0	0	0
Total	322	170 (53)	22 (7)	13 (4)	4 (1)	28 •	27 •	2 •

• Other NEPA-related "injunctions": 8; other non-NEPA-related injunctions: 0.

Note: Numbers in parentheses denote percentage of the total number of cases.

TABLE I-32. Agency NEPA procedures as of March 1, 1976 [38]

U.S. agency	Current procedures		Amendments		Proposed revision	
	Date	Citation [a]	Date	Citation	Date	Citation [a]
Agriculture						
Departmental	5/29/74	39 Fed. Reg. 18678				
Agricultural Stabilization and Conservation Service	5/29/74	39 Fed. Reg. 18678	12/20/74	39 Fed. Reg. 43993		
Animal and Plant Health Inspection Service	1/29/74 [b]	39 Fed. Reg. 3696 [b]				
Farmers Home Administration	8/29/72	37 Fed. Reg. 17459				
Forest Service	5/3/73	38 Fed. Reg. 20919	10/30/74	39 Fed. Reg. 38244		
Rural Electrification Administration	5/20/74	39 Fed. Reg. 23240				
Soil Conservation Service	6/3/74	7 C.F.R. Part 650 39 Fed. Reg. 19646				
Appalachian Regional Commission	6/7/71	36 Fed. Reg. 23676				
[Atomic Energy Commission]						
Nuclear Regulatory Commission (regulatory)	7/18/74	10 C.F.R. Part 51 39 Fed. Reg. 26279				
Energy Research and Development Administration (nonregulatory)	2/14/74	10 C.F.R. Part 11 39 Fed. Reg. 5620				
Canal Zone Government	10/20/72	37 Fed. Reg. 22669				
Central Intelligence Agency	1/28/74	39 Fed. Reg. 3579				
Civil Aeronautics Board	7/1/71	14 C.F.R. §399.110 36 Fed. Reg. 12513	8/25/75 12/19/75	40 Fed. Reg. 37182 14 C.F.R. 312 40 Fed. Reg. 59925		
Department of Commerce	10/23/71	36 Fed. Reg. 21368	2/4/75	40 Fed. Reg. 5175		
National Oceanic and Atmospheric Administration, Coastal Zone Management	8/21/74	36 Fed. Reg. 30153			2/28/75	40 Fed. Reg. 8546
Economic Development Administration	11/13/74	39 Fed. Reg. 40122				

Department of Defense	4/26/74	32 C.F.R. Part 214 39 Fed. Reg. 14699				
Army Corps of Engineers	4/8/74	33 C.F.R. §209.410 39 Fed. Reg. 12737				
Delaware River Basin Commission	7/11/74	18 C.F.R. Part 401 39 Fed. Reg. 25473				
Environmental Protection Agency	4/14/75	40 Fed. Reg. 16813				
Export-Import Bank: no regulations						
Federal Communications Commission	12/19/74	39 Fed. Reg. 43884	11/18/75	40 Fed. Reg. 53391		
Federal Energy Administration	1/30/76	41 Fed. Reg. 4722 10 C.F.R. 208				
Federal Power Commission	12/18/72	Commission Order No. 415-C 37 Fed. Reg. 28412	6/7/73	Commission Order No. 485 guidelines to applicants		
Federal Trade Commission	11/19/71	16 C.F.R. §1.81-1.85 36 Fed. Reg. 22814				
General Services Administration						
Departmental	4/4/75	40 Fed. Reg. 15131				
Property Management and Disposal Service	12/30/71	PMD Order 1095.1A 36 Fed. Reg. 23704				
Public Buildings Service	3/2/73	PBS Order 1095.1B			7/1/75	40 Fed. Reg. 27733
Telecommunications Service	6/30/71	TCS 1095.1				
Health, Education, and Welfare						
Departmental	10/17/73	HEW General Administration Manual, Chapters 30-10 through 30-16				
Food and Drug Administration	3/15/73	21 C.F.R. Parts 6, 601 38 Fed. Reg. 7001			4/16/74	39 Fed. Reg. 13741
Consumer Product Safety Commission: no regulations						

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[a] For procedures that have been published in the Federal Register or have otherwise been formally issued.
[b] Issued in proposed form and currently followed on an interim basis.

TABLE I-32—Continued

U.S. agency	Current procedures		Amendments		Proposed revision	
	Date	Citation [a]	Date	Citation	Date	Citation [a]
Department of Housing and Urban Development						
Community Development Block Grants	7/16/75	40 Fed. Reg. 29992			2/19/76	41 Fed. Reg. 7515
Other programs	7/18/73	38 Fed. Reg. 19182	11/4/75	39 Fed. Reg. 38922		
Interior						
Departmental	9/27/71	36 Fed. Reg. 19343				
Bonneville Power Administration	1/19/72	37 Fed. Reg. 815				
Bureau of Indian Affairs	1/21/74	Bureau Transmittal Memo				
Bureau of Land Management	5/4/72	Bureau Manual Release				
Bureau of Mines	2/9/72	37 Fed. Reg. 2895				
Bureau of Outdoor Recreation	3/24/72	37 Fed. Reg. 6501				
Bureau of Reclamation	11/23/72	37 Fed. Reg. 24910				
Fish and Wildlife Service	11/8/74	Bureau Transmittal Memo				
U.S. Geological Survey	3/11/72	37 Fed. Reg. 5263				
National Park Service	7/29/74	Bureau Manual Release				
Interstate Commerce Commission	3/28/72	49 C.F.R. §1100.250 37 Fed. Reg. 6318				
Department of Justice	2/6/74	28 C.F.R. Part 19 39 Fed. Reg. 4736				
Law Enforcement Assistance Administration						
Department of Labor	3/15/74	29 C.F.R. Part 1999 39 Fed. Reg. 9959				
National Aeronautics and Space Administration	4/10/74	14 C.F.R. §1204.11 39 Fed. Reg. 12999				
National Capital Planning Commission	8/72 [b]	37 Fed. Reg. 16039				
National Science Foundation	1/28/74	45 C.F.R. Part 640 39 Fed. Reg. 3544				

U.S. Postal Service	7/6/72	37 Fed. Reg. 13322			
Small Business Administration	10/20/72	37 Fed. Reg. 22697			
State					
Departmental	8/31/72	37 Fed. Reg. 19167			
Agency for International Development	8/1/75	Policy Determination 63 (supersedes 39 Fed. Reg. 22686-7 of 10/20/72)			
International Boundary and Water Commission	3/14/74	39 Fed. Reg. 9868			
Tennessee Valley Authority	2/14/74	39 Fed. Reg. 5671			
Transportation					
Departmental	9/30/74	39 Fed. Reg. 35232			
Federal Aviation Administration	6/19/73	FAA Order 1050.1A			
Airport Development Act	12/7/70	FAA Order 5050.2A; 36 Fed. Reg. 7724			
Federal Highway Administration	12/2/74	39 Fed. Reg. 41804 33 C.F.R. 771			
U.S. Coast Guard	10/22/75	40 Fed. Reg. 49[illegible]83			
Urban Mass Transportation Administration	2/1/72	DOT Order 5610.1 37 Fed. Reg. 22692			
National Highway Traffic Safety Administration	11/10/75	40 Fed. Reg. 52395 49 C.F.R. 520			
Saint Lawrence Seaway Development Corporation	11/71	Procedure SLS 2-5610.1A	4/24/75 40 Fed. Reg. 18026		
Treasury					
Departmental	4/26/74	39 Fed. Reg. 14796			
Internal Revenue Service	8/12/71	36 Fed. Reg. 15061			
Veterans Administration	6/17/74	39 Fed. Reg. 21016	8/25/75 40 Fed. Reg. 37126		
Water Resources Council	2/10/71	36 Fed. Reg. 23711			

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[a] For procedures that have been published in the *Federal Register* or have otherwise been formally issued.

[b] Issued in proposed form and currently followed on an interim basis.

TABLE I-33. Draft environmental impact statements filed by agency: 1970-1975[323]

U.S. agency	1970	1971	1972	1973	1974	1975
Agriculture	62	79	124	166	179	189
Commerce	0	8	12	15	12	13
Defense	5	27	24	19	26	14
Army Corps of Engineers	119	316	211	243	303	273
Health, Education, and Welfare	0	1	11	4	0	3
Housing and Urban Development	3	23	26	22	21	78[a]
Interior	18	65	107	119	109	67
Justice	0	0	3	1	1	0
Labor	0	0	0	3	1	4
State	0	0	3	1	3	1
Transportation	61	1,293	674	432	360	229
Treasury	2	2	5	0	2	0
Energy Research and Development Administration	—	—	—	—	—	7
Environmental Protection Agency	0	16	13	26	14	23
Federal Energy Administration	—	—	—	—	—	5
Federal Power Commission	0	0	38	16	12	29
General Services Administration	3	34	6	24	26	23
Nuclear Regulatory Commission	—	—	—	—	—	26
All others	14	64	63	26	37	13
Total	319	1,950	1,385	1,145	1,137	1,010

[a] Total includes 27 impact statements prepared by local governments under the Community Development Block Grant Program.

Environmental assessment of U.S. actions in other countries is one of the new applications of the impact statement process. AID has revised its environmental procedures and will now prepare statements and collaborate with assisted countries in the preparation of environmental assessments for foreign-based actions that significantly affect the quality of the human environment. AID will also encourage and assist other countries in developing environmental expertise.

EVENTS IN CONGRESS

The Subcommittee on Fish and Wildlife of the House Merchant Marine Committee held its third set of oversight hearings on NEPA in fall 1975.[323] The subcommittee received 4 days of testimony on implementation of the act from the Army Corps of Engineers, Forest Service, Bureau of Land Management, and from the Departments of Transportation and Housing and Urban Development, as well as from EPA and CEQ. The subcommittee also heard from state highway and other environmental agencies and public interest groups. The subcommittee inquiries focused on agency experiences and successes in integrating the act into planning and decisionmaking, and on ways to improve the process.

TABLE I-34. Program impact statements guidance and use [322]

U.S. agency	Guidelines	Use
Agriculture	Yes	Yes
Agricultural Stabilization and Conservation Service	Yes	Yes
Forest Service	Yes	Yes
Soil Conservation Service	Yes	Yes
Commerce	No	Yes
Defense	Yes	Yes
Air Force	Yes	Yes
Army	Yes	Yes
Navy	Yes	Yes
Corps of Engineers	Yes	Yes
Health, Education, and Welfare	Yes	Yes
Housing and Urban Development	Yes	Yes
Interior	Yes	Yes
Bureau of Indian Affairs	No	Yes
Bureau of Land Management	No	Yes
Bureau of Outdoor Recreation	No	Yes
Bureau of Reclamation	No	No
Fish and Wildlife Service	Yes	Yes
Geological Survey	Yes	Yes
National Park Service	No	Yes
Justice		
Law Enforcement Assistance Administration	No	No
Labor	Yes	Yes
State	No	No
Transportation	No	No
Federal Aviation Administration	No	No
Federal Highway Administration	No	No
Treasury	No	Yes
Energy Research and Development Administration	Yes	Yes
Environmental Protection Agency	No	Not yet
Federal Energy Administration	Yes	Yes
Federal Power Commission	No	Considering
General Services Administration	No	No
Nuclear Regulatory Commission	No	Yes

EVENTS IN THE COURTS

Last year's Annual Report discussed emerging judicial standards for determining the timing and scope of program impact statements. The Supreme Court has since decided an important case on this subject, and another concerning the application of NEPA's impact statement requirement to the administration of federal disclosure laws.

A significant decision was the Supreme Court's reversal of the U.S. Court of Appeals for the District of Columbia in the Northern Great Plains case.[324] The Supreme Court held:

- There was no evidence in the record of a federal action or a proposal for federal action related to coal development on the Northern Great Plains region defined by plaintiffs. (Instead, the scope of proposed federal actions was national, local, or encompassed other regions or sub-regions such as watersheds).
- There was no "contemplation" by federal agencies of coal-related action on the Northern Great Plains region.

- The decision by the Secretary of the Interior not to plan coal programs or actions for the Northern Great Plains region was not arbitrary, and therefore could not be disturbed by a federal court.

The Supreme Court affirmed that NEPA requires comprehensive impact statements when federal plans or proposals involve cumulative or synergistic environmental impacts. It noted the Interior Department's preparation of an impact statement covering a national coal program, and observed that the statement was legally required since Interior was planning a program of national scale. The Supreme Court also noted with approval the Secretary's plans to prepare statements for regions determined by "basin boundaries, drainage areas, areas of common reclamation problems, administrative boundaries, areas of economic interdependence, and other relevant factors." [325]

In this same ruling, which sparked dissent from two Justices,[326] the Supreme Court also disapproved the *SIPI* [327] test (discussed in our Sixth Annual Report) for determining when courts could intervene to require an impact statement during the development of a federal proposal. The majority said the balancing test in *SIPI* went beyond courts' authority to intervene in federal planning. It stated that agencies have a duty to study environmental factors and consult with other agencies during the evolution of a proposal, but that *courts* do not enter the process until an agency official makes a "report or recommendation," and a plaintiff challenges the absence or the adequacy of a final impact statement.[328] Because the majority provided no standards for identifying this "report or recommendation" juncture, however, agencies and courts receive little guidance on this timing question from the court's opinion.

Finally, the Supreme Court indicated that in some circumstances—when approval of one proposal or action is not intimately related to other proposed actions covered in a comprehensive impact statement—the single action may proceed before the final comprehensive statement is complete if an impact statement is prepared on the single proposal or action and its effects are considered in the comprehensive statement.[329] This interpretation is consistent with previous lower court decisions,[330] including two recent program statement cases of significance.

In the first case, the U.S. Court of Appeals for the Second Circuit reversed itself in *Conservation Society of Southern Vermont* v. *Secretary of Transportation*,[331] following remand by the Supreme Court.[332] Reconsideration led the court of appeals to conclude that a 20-mile segment of route 7 (instead of the entire 280-mile corridor) was the proper scope of the impact statement because the smaller segment was independently useful and did not involve commitments to build the entire highway.[333]

Using the same test, the same court later enjoined the Nuclear Regulatory Commission's decision to authorize licensing of nuclear reprocessing plants before the final program impact statement was completed.[334] In this case, the court concluded that interim licensing *would* involve a decision in principle to permit commercial reprocessing of spent nuclear fuel, *would* involve irreversible commitments to reprocessing, and thus could not be undertaken until an adequate comprehensive statement was completed.

In the second Supreme Court NEPA case decided this year, the Court held in *Flint Ridge Development Co.* v. *Scenic Rivers Association* [335] that the impact statement requirement of § 102(2)(C) was inapplicable to receipt and review by HUD of property information statements filed by developers under the Interstate Land Sales Full Disclosure Act.[336] Property statements become automatically effective 30 days after filing with HUD unless they are incomplete or otherwise deficient. The Court reasoned, based on CEQ reports,[337] that HUD could not prepare draft and final impact statements within 30 days, and ruled that HUD did not have authority to extend the 30-day period solely for the purpose of preparing and circulating impact statements. At the same time, the Supreme Court pointed out that HUD had other duties under NEPA, and could require developers to submit a wide range of environmental information in property statements.

At this writing, CEQ expects to provide additional guidance to agencies on these two Supreme Court opinions.

EVENTS AMONG THE STATES

One of the principal findings of the Council's report on impact statements was that state governments frequently use federal impact statements not only to influence federal decisions important to the state, but also to help improve state plans and decisions. Many states believe, however, that they need better opportunities to participate in the federal impact statement process. Acting through a task force of the National Governors' Conference, the states recommended to CEQ earlier notice to their state and areawide clearinghouses of federal agencies' decisions on whether to prepare environmental impact statements. States also asked for better coordination between federal and state impact statement requirements.

As of April 1976, 26 states had requirements of their own. The scope of these requirements varies considerably. Fourteen states and Puerto Rico have enacted "little NEPAs" of general application; [338] five states have environmental analysis requirements of limited application; [339] and six have procedures adopted by administrative action that are roughly equivalent to NEPA.[340] Among these 26 states some, Nevada for example, require environmental analysis only for certain limited, specified activities such as electric powerplant siting. Others, like Massachusetts, cover only state-initiated actions, omitting those that require a state permit or license. Michigan, on the other hand, requires that an impact statement be filed for any major state activity that "raises public concern or controversy," while North Carolina authorizes local governments to require statements from special purpose districts or private developers of major developments.

California, Minnesota, Washington, and Wisconsin have comprehensive requirements that were improved and refined in the past year. California's experience is by now extensive; about 3,800 impact statements had been prepared by the end of 1975, but the majority are short summaries. One new development in the state resulted from a state court determination that California's Environmental Quality Act (CEQA) applied to the application of timber companies for permits to cut timber on state lands. The state legislature responded by suspending CEQA's applicability to timber companies and, after further consideration, by passing Senate Bill 707. This bill, approved by the Governor on September 30, 1975, allowed a private industry seeking a permit and meeting certain threshold criteria to submit a short statement on its proposed action, its alternatives and identified impacts. This assessment would be the "functional equivalent" of the environmental impact report required by CEQA. Threshold criteria for eligible industries have been narrowly defined, however, and to date only the forestry industry has used the process. The law is scheduled to expire in 1977.

About 160 assessments and 34 impact statements had been prepared in Minnesota by late 1975. In March 1976, the state Environmental Quality Council, which has veto authority over impact statement sufficiency, decided to publish an "EQC Monitor," covering its decisions and pending actions as well as negative declarations by agencies, notices of hearings, and dispositions, on which the public has 30 days to comment or appeal.

Wisconsin's Environmental Policy Act of 1971 is also effective. Approximately 65 impact statements were prepared in 1975. A new Executive Order [341] in February 1976 strengthened the act's reporting and hearing requirements. It reemphasized the need for environmental planning for long-range projects and programs, rather than individual projects and added a requirement for impact statements to analyze economic and aesthetic effects.

The state of Washington, which prepared about 650 draft impact statements in 1975, also continued to improve its impact statement process. It developed new statewide guidelines, effective in January 1976, to better define actions covered by the statute, to establish specific criteria for statements, and to eliminate uncertainties about procedure. The temporary Council on Environmental Policy, established to write statement guidelines, ceased to exist and transferred all of its duties to the state's Department of Ecology.

New York became the latest state to enact an impact statement requirement in June 1975, modeling its law after that of California. After public hearings, the state's Department of Environmental Conservation adopted impact statement regulations in March 1976 to go into effect in June 1976. However, in May 1976, the statute was amended to provide for a phased implementation of impact statement requirements. The law will now become effective with respect to actions directly undertaken by state agencies in September 1976. It will apply to local government actions in June 1977, and to essentially private actions, for which state or local government permits are required, in September 1977.

Many other states with impact statement requirements faced budget curtailments in 1975. Connecticut, Indiana, Massachusetts, and North Carolina reported budget cuts for environmental review programs. In Maryland, budget cuts diminished the number of state construction projects, and therefore reduced the need for environmental review of new construction.

In view of the diversity of state impact statement requirements, it is not easy to generalize about their overall effect in improving planning and decisionmaking. Some states' criticisms of unnecessary red tape, delays, and costs have created pressures to reduce the scope of statement requirements. But state agencies with the most experience in using impact statements are impressed with their value for decisionmaking and with the opportunity they provide for public participation in government. A March 1976 study of the California impact report process made by the Governor's Office of Planning and Research, concluded that many criticisms of the impact report process had proved, on analysis, to be based on misinformation. The report found that the process was working well. It recommended refinement and improvement of a sound framework for environmental analysis, as CEQ's report did for the federal environmental impact statement process.

INTERNATIONAL EVENTS

Awareness of the environment is increasing, in both developing countries and industrialized nations. Economic development has improved the quality of life in industrialized nations and in some developing countries, but the environmental damage associated with higher levels of resource consumption tends to undercut some of this progress. The more rapidly developing countries, such as Brazil and Colombia, have expressed concern about accompanying environmental implications. In poor countries, poverty and hunger, intensified by rapidly growing populations, are obvious limitations on the quality of life.

Whether the quality of the global environment is improving, however, is the test of measures taken. Some successes in improving the environment have been evidenced in Japan, which has succeeded in reducing the levels of sulfur dioxide in the air,[342] and has set up clean petrochemical centers.[343] London has dramatically reduced air pollution and has succeeded in cleaning up the Thames River.

Industrialized nations are improving and extending environmental regulations, while richer developing countries, especially the oil producing nations, are introducing laws and establishing institutions to improve environmental quality.

Environmental indicators, monitoring systems, and models are being used more frequently and to greater advantage in industrialized nations. Some multilateral organizations, such as the Economic Commission for Europe (ECE) and the Organisation for Economic Co-operation and Development (OECD), are moving ahead in the use of computerized models, often with U.S. leadership and cooperation. Some developing countries also are using basic environmental monitoring techniques.

Countries are turning to bilateral and multilateral relationships for solutions to local, as well as transboundary, environmental problems in the increased recognition that many problems can be solved better by working together. The current status of these relationships is discussed.

U.S. BILATERAL RELATIONSHIPS

The United States is continuing bilateral relationships in the environmental field with Canada, the European Communities, the Federal Republic of Germany, Japan, Mexico, Poland, and Spain.[344] For example, on October 22, 1975, the United States and Canada requested the International Joint Commission to examine the transboundary implications of the Garrison Diversion Unit in North Dakota.[345] In a November meeting, the two countries explored the possibilities for better coordination of environmental impact assessment for projects in either country that might affect the other.

The United States and Mexico are collaborating on efforts in water and air pollution and solid waste disposal, especially in border areas, where the International Boundary Water Commission is still a key agency. The two countries have made a cooperative arrangement on assistance in salvage of vessels and joint action in the case of oil spills. Memoranda of Understanding have been concluded for endangered species and marine mammals, and for cooperation on natural areas and border parks.[346]

The bilateral agreement with the U.S.S.R. has grown to 39 active projects in 11 major areas of cooperation. Specialists from both countries are designing equipment to desulfurize gas emissions from electric powerplants, and are also designing facilities for pretreatment of fuels for air pollution abatement. In a joint balloon experiment at Rylsk (U.S.S.R.), U.S. and Soviet scientists measured stratospheric aerosols. Soviet biologists and specialists from the U.S. Fish and Wildlife Service moved 41 musk oxen, a gift from the United States to the Soviet Union, from Nunivak Island, Alaska, to Wrangell Island and the Taimyi Peninsula of the U.S.S.R. to reëstablish the species in Siberia.[347]

An agreement on cooperation in the field of environmental protection, signed on August 5, 1975, formalized a cooperative environmental program which was already underway between the United States and Japan. The first meeting of the Joint Planning and Coordination Committee, held in Washington, February 26-27, 1976, provided discussions regarding programs held in nine diverse fields: sewage treatment technology, air pollution-related meteorology, photochemical smog, management of bottom sediment containing toxic pollutants, solid waste management, automobile pollution control, health effects of pollutants, environmental impact assessment, and identification and control of toxic substances. Procedures were developed to implement the agreement.[348]

An agreement with Spain on scientific and technical cooperation was signed on August 20, 1975. Part of this agreement called for cooperation in several areas, encompassing several projects already underway: monitoring, reduction, and, where feasible, elimination of environmental pollution; conservation of wildlife habitats; and urban and regional planning directed to improving the quality of human life.[349]

EPA has cooperative programs currently underway or being negotiated with six countries—Egypt, India, Pakistan, Poland, Tunisia, and Yugoslavia. These programs are financed by excess foreign currency funds available under Public Law 83-480.[350] Projects with Poland include studies of industrial and municipal wastewater treatment, use and disposal of sludge, mined water purification, waste residual management and reclamation of surface-mined lands, and health effects of air and water pollution. Several new projects are planned in Poland, including an intensive effort in energy-related environmental research.

A multidisciplinary study is being conducted on the environmental effects of the Aswan Dam in Egypt. Other programs cover a broad range of environmental concerns, including air and water pollution, safe use of pesticides, and an analysis of Mediterranean desert ecosystems.

The United States has continued a bilateral relationship with the Commission of the European Communities (CEC). At meetings in 1974 and 1975, information was exchanged on many subjects including health effects of pesticides; air, water, and noise pollution; toxic chemical concerns; energy-environment problems; the polluter pays principle;[351] and environmental assessments.

INTERNATIONAL AGREEMENTS AFFECTING THE ENVIRONMENT

The 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage became effective on December 17, 1975. The first consultative meeting under the 1972 Ocean Dumping Convention (effective in August 1975) is planned for September

1976. An organizational meeting on the Endangered Species Convention, which took effect in July 1975, is scheduled for late 1976. Twenty-two nations have now ratified and 57 have signed this convention.

Several other conventions affecting the world's oceans and their resources are awaiting the requisite number of ratifications; all have been signed, but have not yet been ratified by the United States. Further negotiation of these conventions is taking place in 1976 at sessions of the Third United Nations Law of the Sea Conference in New York. The questions under consideration include exploitation of seabed resources, extent of coastal waters and the nature of coastal state jurisdiction over them, protection of the marine environment from land-based sources, and vessel operations.

Two other agreements merit special mention: the Helsinki Agreement on Security and Cooperation in Europe, and the Environmental Modification Agreement with the U.S.S.R. The Helsinki Agreement, signed on August 1, 1975, by Canada, 32 European countries, and the United States, calls for cooperation in the fields of energy, new technologies for rational use of resources, transport technology, oceanography, seismology, space research (including study of the Earth's natural resources and the natural environment by remote sensing), control of air pollution, control of water pollution and use of fresh water, use of the land and soils, nature conservation and nature reserves, and the improvement of environmental conditions in areas of human settlements. The UN Economic Commission for Europe is already working on two issues emphasized in the agreement: problems of long-range transport of air pollution, and environmental impacts of economic activities and technological development.

The United States and the Soviet Union, on August 21, 1975, jointly presented at the Geneva Disarmament Conference (Committee of the Conference on Disarmament, CCD) a draft treaty that would ban catastrophic methods of environmental warfare (Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques),[352] which they had already signed as a bilateral agreement as originally intended. However, it became a multilateral issue after the Soviet Union brought up the subject in the UN General Assembly in fall 1974.

MULTILATERAL INTERNATIONAL ORGANIZATIONS

The United Nations Conference on Human Settlements (Habitat) held at Vancouver, Canada, from May 31 to June 11, was a major event in 1976. In its Declaration of Principles, the conference recognized that solutions must be found to the many complex problems associated with the conditions of human life in urban areas because cities are the dwelling place of 80 percent of the human population. Recommendations for national action were approved, providing the stimulus to improve national policies on human settlements, city planning, national institutions, infrastructure (including shelter), and services (especially transportation), health and education, land use, and public participation in the solution of human settlements problems.

Other significant meetings were held, such as the UNEP-sponsored meeting in Barcelona in February 1976, in which 12 Mediterranean nations signed a convention binding them to cooperate in "all appropriate measures to prevent pollution" in their common sea.[353] Two protocols were also signed: one protocol prohibited dumping of such substances as DDT, PCBs, crude oil, and other petroleum hydrocarbons; mercury and cadmium, persistent plastics and radioactive wastes; and imposed stringent conditions on the dumping of such materials as lead, copper, arsenic, and fluorides. The other protocol provided for cooperation in combatting pollution by oil or other harmful substances in cases of emergency.[353]

UNEP established the International Referral System (IRS), an environmental reference service that now has a network of referral centers in 58 countries. UNEP also laid the groundwork for the International Register of Potentially Toxic Chemicals, an information exchange on the properties of chemicals, their production and use, their hazardous effects, standards and laws used to regulate them, and emergency control measures. It also initiated discussions with other United Nations agencies for the design and implementation of the Global Environmental Monitoring System (GEMS). In a related action, UNEP continued to provide assistance to the Food and Agriculture Organization (FAO) for the development of methods to assess, on a global basis, renewable natural resources, starting with soils and tropical forests. It also provided funds to FAO, the United Nations Educational, Scientific, and Cultural Organization (UNESCO), and other institutions for the conservation of genetic resources.

On December 11-12, 1975, in Geneva, the Fifth Session of the UN Environment Coordination Board stated that it would systematically review the environmental programs of the major UN agencies to ensure more effective coordination of these programs within the UN system.[354] The board considered it important that UNEP consult with other agencies before making any final decisions regarding important initiatives in their field of competence, and that organizations also consult with UNEP at the earliest possible stage on programs with environmental dimensions.

Environmental education was the subject of a joint UNEP-UNESCO sponsored international workshop held in Belgrade, Yugoslavia, in October 1975. The "Belgrade Charter," approved by this workshop for further considerations by regional meetings and by the planned 1977 ministerial-level Conference on Environmental Education, declared that environmental education should consider the environment in its totality—natural and human-made, ecological, political, economic, technological, social, cultural, and aesthetic.[355] The goal of environmental education, as stated in the charter, is "to develop a world population that is aware of, and concerned about the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively toward solution of current problems and the prevention of new ones."

The Belgrade Charter speaks of the inequality between the poor and the rich among nations and within nations which "although primarily caused by a relatively small number of nations, affects all of humanity." [355]

The charter calls for a "new global ethic . . . which recognizes the complex ever-changing relationships between humanity and nature and between people." It refers to the "New International Economic Order," which calls for a new concept of development, and "which takes into account . . . the balance and harmony between humanity and the environment." This new kind of development, says the Charter, "will demand the assurance of perpetual peace through coexistence and cooperation among nations with different social systems." [355]

The U.S. Delegation at the Fourth Session of the UNEP Governing Council on April 8, 1976, noting the expense of environmental education and training programs thus far implemented by UNEP, in 1976 and 1977, supported the approach of the Belgrade Charter, but recommended that it not be used until it is an approved document.

Other activities of UNESCO's Environmental Education Unit, in cooperation with UNEP, are a worldwide assessment of environmental education needs, a comprehensive and continuing literature search of global environmental education resources, and the start of *Connect,* a global environmental education information network.

The Belgrade meeting laid the foundation for nine regional seminars where the goals of the Belgrade Charter will be further discussed and related to environmental education opportunities in specific areas of the world. A North American Regional Seminar will bring environmental educators to St. Louis, Missouri, in October 1976.

Environmental activities of other UN agencies intensified in the past year. The World Meteorological Organization (WMO) is developing the GEMS for monitoring background air pollution.[356] The World Health Organization (WHO) is active in worldwide efforts to improve water supply, waste disposal, occupational health, and radiation hazards. The Inter-Governmental Maritime Consultative Organization, Marine Environment Protection Committee, is working on the implementation of the 1973 International Convention on the Prevention of Pollution from ships and is developing information which will help government provide adequate reception facilities for wastes containing oil and other noxious substances.[357] The UNESCO Man and the Biosphere program now involves participation by 81 countries coordinating research and training efforts directed at improving management of natural resources.

The Environment Committee of the OECD, at the March 1976 plenary in Paris, developed a 1976 and 1977 work program involving projects that range from assessment of the environmental impacts of energy production to traffic limitation methods for improving the urban environment.

The Environment Committee is nearing completion of a report and recommendations on energy and the environment, including siting of powerplants and the interdependence of energy policies with those directed at reducing sulfur oxide pollution.

A second Industrial Consultation on PCBs, called for by the United States, will attempt more effective implementation of the OECD's 1973 decision to discourage the use of PCBs and to permit countries to exchange information and policies on substitutes, disposal, and labeling.

The United States is continuing to participate actively in NATO's Committee on the Challenges of Modern Society (CCMS). The October 1975 CCMS plenary in Brussels adopted a new study on nutrition and health, which will be piloted by Canada. The study will focus on the effects of eating habits and lifestyles on the health of citizens of the industrialized countries. A new pilot study will be

The McClusky Canal, part of the Garrison Diversion Unit, a large Bureau of Reclamation irrigation project in North Dakota, slumped in 1974. This project has international importance because it may adversely affect Canadian waters (Photo credit: Richard Madson) considered on remote sensing techniques, proposed by France and applicable to pollution of the seas by oil spills.

The Pan American Health Organization (PAHO), the western hemisphere arm of the World Health Organization, is currently intensifying a program for information exchange on environmental health matters. The Economic Commission for Latin America (ECLA) has completed a draft of a first assessment of the environmental situation in Latin America, with heavy emphasis on the human settlements problems.[358]

The Organization of American States (OAS), with financial support from UNEP and the UN Development Program, contracted a pilot environmental study as part of a feasibility study for development of the Bermejo River in Argentina. Work on the environmental study started in September 1975. According to the study concept, it will include a methodological model for the integrated assessment of environmental impacts in the early, rather than final, stages of a project. Environmental assessments also form an integral part of feasibility studies underway for the development of the Pilcomayo River Basin of Argentina, Paraguay, and Bolivia, begun in February 1975, and the Upper Paraguay Basin of Brazil, begun in April 1976.

ECONOMICS

Each year we estimate how much the nation will be spending on pollution control over the coming decade because of federal environmental legislation. This year's estimates of incremental abatement costs resulting from federal requirements are presented in Table I-35. (Total costs are presented in the appendix to this chapter.) From 1975 through 1984, the nation is expected to spend a 10-year total of $258.8 billion on the cleanup measures that are currently required. Approximately 61 percent ($156.8 billion) of this will be spent by private industry, predominantly for air and water pollution control; 20 percent ($51.7 billion) will be spent by government, largely for municipal wastewater treatment; and 19 percent ($50.3 billion) will be spent directly by consumers, primarily for automobile emissions control.

This year's estimates of pollution abatement costs are essentially the same as last year's.[359] The dollar amounts are somewhat higher because they have been adjusted to take account of inflation between 1974 and 1975, because 1983 (a relatively high cost year) has been added to the estimating period and 1974 (a lower cost year) has been removed from the estimating period, and because some business costs (for industrial solid waste disposal) were included for the first time this year (see the appendix to this chapter). In terms of real resources consumed, mobile source estimates have been reduced to reflect the expected easing of emissions requirements, and some minor

TABLE I-35. Estimated incremental pollution control expenditures (in billions of 1975 dollars): 1975-1984 [a]

Pollutant/source	1975			1984			Cumulative (1975-1984)			
	Operation and maintenance costs [b]	Capital costs [b]	Total annual costs [c]	Operation and maintenance costs [b]	Capital costs [b]	Total annual costs [c]	Capital investment	Operation and maintenance costs [b]	Capital costs [b]	Total annual costs [c]
Air pollution										
Public	0.1	0.1	0.2	0.6	0.2	0.8	1.9	4.2	1.8	6.0
Private										
Mobile	3.4	1.5	4.9	1.3	4.4	5.7	29.1	20.9	31.7	52.6
Industrial	1.2	1.5	2.7	3.1	3.6	6.7	15.1	21.7	25.4	47.1
Utilities	0.6	0.6	1.2	2.7	2.7	5.4	15.6	15.4	15.4	30.8
Subtotal	**5.3**	**3.7**	**9.0**	**7.7**	**10.9**	**18.6**	**61.7**	**62.2**	**74.3**	**136.5**
Water pollution										
Public										
Federal	0.2	<0.05	0.2	0.2	0.1	0.3	2.0	2.1	0.4	2.5
State and local	1.1	0.2	1.3	4.8	2.3	7.1	24.2	28.6	11.2	39.8
Private										
Industrial	1.3	1.2	2.5	6.0	4.7	10.7	36.5	30.9	26.1	57.0
Utilities	0.4	0.3	0.7	0.9	0.5	1.4	2.3	7.2	4.3	11.5
Subtotal	**3.0**	**1.7**	**4.7**	**11.9**	**7.6**	**19.5**	**65.0**	**68.8**	**42.0**	**110.8**
Radiation										
Nuclear powerplants	**<0.05**	**<0.05**	**<0.05**	**<0.05**	**<0.05**	**<0.05**	**0.2**	**0.1**	**<0.05**	**0.2**
Solid waste										
Public	0.2	0.1	0.3	0.3	0.1	0.4	1.1	2.6	0.8	3.4
Private	0.3	0.1	0.4	0.7	0.2	0.9	0.8	4.3	0.2	4.5
Subtotal	**0.5**	**0.2**	**0.7**	**1.0**	**0.3**	**1.3**	**1.9**	**6.9**	**1.0**	**7.9**
Land reclamation										
Surface mining [d]										
Noise	**NA**	**NA**	**NA**	**0.3**	**0.3**	**0.6**	**1.7**	**1.8**	**1.6**	**3.4**
Total	**8.8**	**5.6**	**14.4**	**20.9**	**19.1**	**40.0**	**130.5**	**139.8**	**118.9**	**258.8**

[a] Incremental costs are expenditures made pursuant to federal environmental legislation beyond those that would have been made in the absence of this legislation.

[b] Interest and depreciation.

[c] Operation and maintenance plus capital costs.

[d] Not included in this year's estimate.

NA = not available.

changes have been made for specific industries where improved cost estimates have become available.

Of an estimated $34.8 billion that the nation is spending in 1976 for pollution control, only $17.7 billion of abatement costs is being spent in response to federal environmental legislation. The rest consists of expenditures, such as costs of solid waste disposal, that would most likely be made anyway. The breakdown of these costs is shown in Figure I-13. On the average, we are spending an estimated $82 per capita to meet the requirements of state and federal environmental legislation; $43 in investment, and $39 in operating and maintenance costs. Of total outlays, approximately 47 percent of the expenditures is made by private industry, 34 percent by government, and 19 percent directly by the consumer. Seventy-eight percent is for abating air and water pollution; 15 percent for solid waste manage-

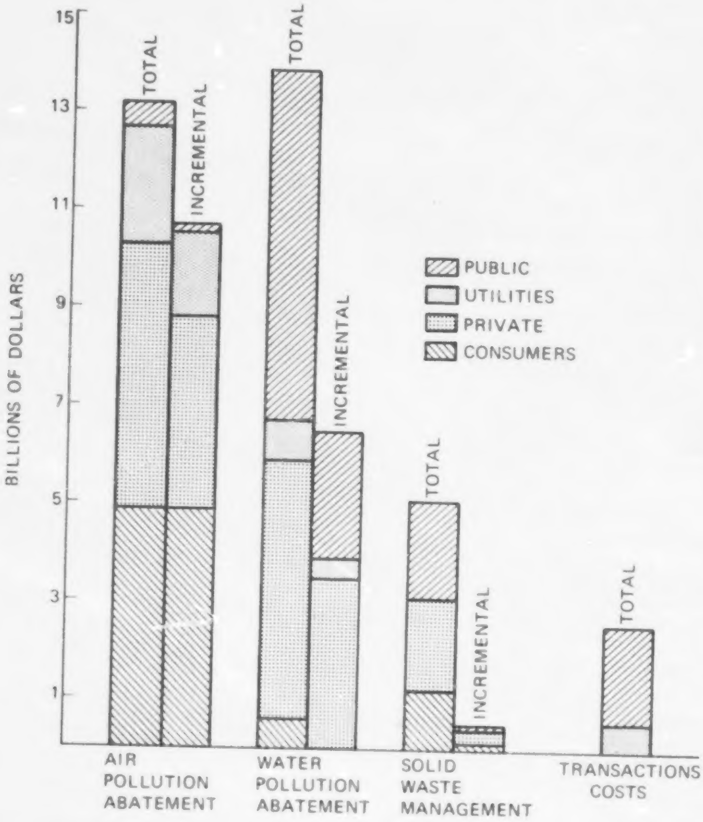


FIGURE I-13. **Preliminary estimates of pollution control expenditures for 1976**

ment; and 7 percent for administration, monitoring, research, and other transaction costs.

The abatement costs are only one element affecting the economics of our environmental programs. As Chapter II indicates, we are making noticeable progress in cleaning up our environment, and thus are beginning to experience the economic benefits of less ill health, fewer lives lost, less deterioration of materials, fewer losses of crops, and so forth. Last year's Annual Report summarized, in detail, our knowledge of the magnitude of these damage costs.[360] Although many of these costs cannot be easily quantified, our pollution control programs are expected to result in substantial net economic gain—the value of the reduced damage costs will far exceed the increase in abatement and other costs. Unfortunately, little effort has been made to monitor changes in damage costs from year to year, so we cannot keep a running tally as we can with abatement costs. Nevertheless, these gains are real, and the emphasis here on abatement costs results more from the relative availability of information than from the relative importance of this type of cost.

MACRO-ECONOMIC IMPACTS

During the past year, the state of the U.S. economy has been a matter of major concern. Recent events have been encouraging, but inflation, unemployment, the rate of economic growth and the unavailability of capital remain serious issues. We are continuing to analyze these problems insofar as they are affected by environmental programs. This year we sponsored an updated macro-economic analysis using recent economic projections and pollution abatement cost estimates.[361]

Inflation

Environmental protection measures add something to the price of the goods consumers buy, but the amount, spread out over all prices, is modest. Pollution control expenditures may raise prices in several ways. For instance, the price of a new car includes three types of pollution abatement costs: the cost of the emissions control system installed on the car, the cost of abating pollution at the automobile manufacturing plant, and the increased cost of the raw materials due to pollution control expenditures made by the steel, plastics, paper, and other raw materials industries. The price of an average U.S. 1976 automobile may be approximately $280 higher than it would otherwise be because of our environmental legislation, with 71 percent of this cost increase attributable to the emissions control system itself. There may also be some additional costs associated with operating and maintaining the car.

The automobile, however, is an extreme example. The price of most consumer items is affected much less. As indicated in Figure I-14, it is estimated that the Consumer Price Index (the most com-

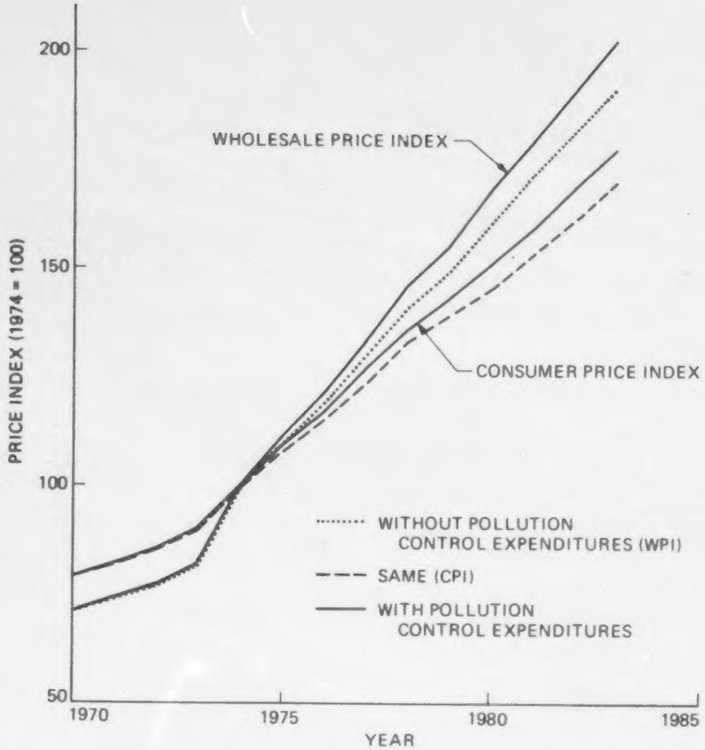


FIGURE I-14. **Estimated Consumer and Wholesale Price Indices (CPI and WPI) with and without pollution abatement expenditures**

mon measure of inflation) is currently only 1.6 percent above what it would be in the absence of pollution control expenditures. This difference is expected to increase to 4.0 percent by 1983. Therefore the average rate of increase from 1970 through 1983 will be 0.3 to 0.4 percent per year higher than it would be without pollution control expenditures. These estimates do not include any economic bottlenecks caused by pollution control requirements, which could cause additional price increases. Such bottlenecks are almost impossible to predict, or even to attribute to a particular cause (such as pollution control requirements) if they do occur.

Economic Growth

Environmental legislation can either stimulate or retard economic growth depending upon economic conditions and the amount of investment diverted from other uses to controlling pollution. During the past year or two, both the public and private sectors have, because of environmental legislation, been investing more than they otherwise would have. The resulting demand for goods and services has tended to increase the measured Gross National Product (GNP). Environmental requirements can also reduce the GNP either by causing temporary shortages and other bottlenecks that disrupt the smooth operation of the economy or by diverting investment from the production of goods and services included in the measure to environmental improvement, which is not included.

The most recent macro-economic projections reproduced in Figure I-15 indicate that the GNP is slightly higher now than it would have been without environmental regulations because environmental expenditures have made use of labor and resources that otherwise would have been left unused. As the nation pulls out of the recession, the effect of this stimulus on the GNP should decrease as environ-

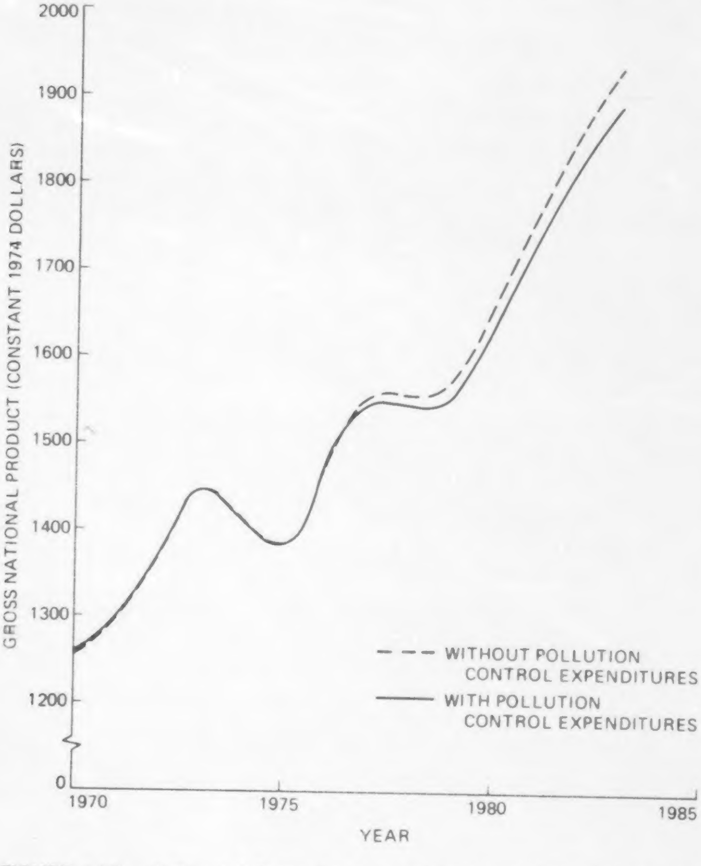


FIGURE I-15. Estimated Gross National Product with and without pollution abatement expenditures

mental expenditures are made in place of, rather than in addition to, other expenditures. Toward the end of the decade, a slight depressing effect on the economy is projected because of the higher prices caused by pollution control expenditures. The net effect is that the real GNP is projected to be 2.2 percent lower by the end of the decade than it would have been without environmental legislation.

Capital Investment

Concern about sufficiency of capital has grown during the last year. Will the economy be able to generate enough capital to make all the investments needed to satisfy our society's many goals—e.g., for a cleaner environment, energy self-sufficiency, more goods and services, and better housing? [362] The answer is probably no. Interest rates are expected to remain at relatively high levels, fluctuating around the levels experienced during the last couple of years, discouraging many investments that might be made if interest rates were lower. The impact is likely to be most severe on the housing market. Figure I-16 indicates how interest rates are projected to be influenced by the pollution control investment being made over the next decade.

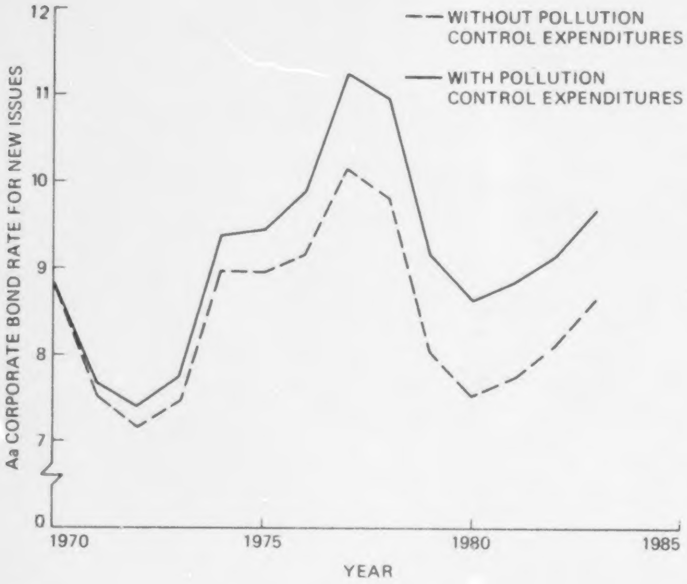


FIGURE I-16. Estimated interest rates with and without pollution control expenditures

A common response to the problem of scarce capital is to attempt to make capital cheaper for some purposes than for others. Investment tax credits and accelerated depreciation subsidize business investments. Loan guarantees, price guarantees, and special investment funds have been proposed for energy investments. The federal government has subsidized housing in many different ways for decades. All of these programs serve to lower the cost of capital for specific purposes.[363] There are also several such programs favoring pollution control investments.

Business can use pollution control facilities financed by industrial revenue bonds issued by state and local governments. The interest from these bonds is exempt from federal taxation, and therefore they can be sold at a lower interest rate than normal bonds. At least $2.5 billion in industrial development bonds was publicly reported to have been issued for pollution abatement in 1975, and the total amount of issues may have been much more.[364] The use of industrial revenue bonds is estimated to reduce by about 20 percent the interest rates at which the firms can borrow money.[365]

Many analysts consider industrial revenue bonds to be a relatively inefficient form of subsidy. The use of industrial revenue bonds deprives the federal government of tax revenue and, because the bonds compete for funds in tax-free bond markets, they increase the amount of interest that all municipalities pay for all of their new borrowing costs.

Various estimates indicate that, on the average, each dollar of subsidy industries receive from these bonds costs government $3 to $4 in reduced tax revenues and higher interest costs for other state and local government borrowing.[366] The loss of tax revenues was estimated at $95 million in 1974. From 1975 to 1983, an estimated subsidy of $3.2 billion (for $38 billion in pollution control bonds) is projected to cost the federal government approximately $3 billion in lost tax revenues, and state and local governments $9.6 billion in increased borrowing costs. (The difference between the public cost and the amount of subsidy is the amount of increased income going to bond holders.)[366] Industrial revenue bonds also tend to favor larger corporations because smaller firms often cannot afford the underwriting costs and are not able to sell their bonds in the municipal bond market.

A 1976 amendment to the Small Business Act attempts to provide small business better access to tax exempt financing.[367] Two other subsidy programs that tend to favor smaller businesses are the small business loans program and the municipal treatment grants program. A special small business loans program is jointly administered by EPA and the Small Business Administration (SBA).[368] EPA verifies that the proposed investment is for abating pollution; if the firm making the investment qualifies under its regulations, the SBA will loan it the necessary funds for up to 30 years at a low interest rate under its economic disaster loan program. The program has approved less than $20 million in loans since its beginning in 1974, a relatively minor amount compared to the billions of dollars that have already been invested for pollution control. There is no information, however, about how much of the overall investment has been made by small businesses.

The municipal grants program for wastewater treatment facilities is probably the most important source of subsidy for small businesses, although at present it is impossible to determine the extent of the subsidy. Industries can dispose of their wastes in a municipal waste system if their wastes do not interfere with the system's operations, and as long as the industry pays a user charge that covers the investment and operating costs of treating its wastes. Even though it is expected to pay its share of costs, the industry in effect receives a subsidy because it does not have to pay any interest on the federal share (75 percent) of the investment, and because, for small businesses, the average treatment cost is less in the municipal system than it would be if the firm had to build its own waste treatment system. The NCWQ estimated the extent of the subsidy at 45 percent, but this amount depends greatly upon how much "pretreatment" the firm has to give its wastes before disposing of them in the municipal system.[369] Many of the pretreatment regulations have not yet been issued. The municipal system subsidy especially helps smaller plants and firms because larger firms often find it cheaper to treat their own wastes, taking advantage of economies of scale and designing the treatment system to deal directly with their specific waste problems.

Other subsidies available for pollution control investment include Economic Development Administration loans for firms in designated areas of high unemployment and, in some states and localities, exemptions from property and sales or use taxes and deductions from income and franchise taxes.[370] These subsidies are generally less important than those mentioned previously. The federal investment tax credit available for all industrial investment also subsidizes pollution control investments.

A major problem with most of these subsidies is that they favor discrete, end-of-pipe investments rather than various types of process changes which may be more efficient and less costly, but which cannot take advantage of any of the available subsidy schemes.

Employment

The possible impact of pollution control programs on employment has been an issue of special concern during the past year as the country has experienced high unemployment rates. Pollution control programs can affect employment in both a positive and a negative fashion.[371] Possible negative effects can occur for several different reasons. Pollution control regulations can force plants to close. They can interfere with the normal expansion of production capacity (or by causing price increases, can lead to a reduced demand). They might stimulate firms to shift new production capacity out of the United States to countries that have less stringent pollution control regulations.

On the other hand, cleaning up the environment also creates jobs. People are employed to construct pollution abatement systems, manufacture the equipment used in these systems, and operate and maintain the systems after they are built.

To monitor job losses, EPA maintains an "early warning system" to collect information on threatened and actual plant closings which, it is alleged, are caused in part by pollution control requirements. This system has found evidence of 81 such closings affecting 17,600 employees.[372] The Bureau of Economic Analysis (U.S. Department of Commerce) also attempted to obtain information on closings in its 1975 and 1976 surveys, but its results are difficult to interpret and have not been adequately compared with those of EPA.[373] At least one other survey found little evidence that environmental regulations have been a significant factor in plant closings.[374]

Most plant closures occur in older facilities that economic considerations would probably have forced to close anyway, especially during a recession such as the country has experienced. Even in an affected plant the number of lost jobs may well be less than the number of employees affected. U.S. Steel claimed that closing its Gary, Indiana, open-hearth furnaces would affect at least 2,500 workers, but only 250 to 500 employees actually lost their jobs. In addition, the production lost from closing one facility is likely to be made up by increasing production—and therefore employment—at another facility. Such factors make it difficult to assess the impact of closings on employment, although they clearly can create serious local problems, especially when they occur in areas already suffering high unemployment rates.

Almost all analyses involving plants moving abroad indicate that it is a relatively minor problem with little employment impact.[375]

On the other side of the ledger, environmental programs have also created employment. Two studies of jobs associated with the construction of municipal wastewater treatment plants indicate that the total number of jobs associated with $1 billion of expenditures for this purpose ranges from 53,000 to 82,000, even though only about 20,000 workers are directly employed to construct the facilities.[376] These estimates include not only the direct employment at the construction site and in making the equipment, but also such indirect employment as that involved in providing goods and services for the personal consumption of those persons directly employed.

A recent analysis of the petroleum refining industry estimated that 13,000 additional workers may be required to operate and maintain its pollution control equipment, whereas no jobs are expected to be lost because of plant closures.[377]

The Bureau of Labor Statistics, in an analysis of employment associated with different aspects of federal environmental expenditures, estimated that 76 to 78 jobs resulted from $1 million spent on research and on administering the pollution control programs.[378] The Bureau of the Census estimated that in 1973 there were more than 225,000 full-time federal, state, and local government jobs associated with air and water pollution control and solid waste management.[379]

A very crude estimate of total employment related to pollution control expenditures may be made by the following comparison. The nation is spending in total about 2 percent of its GNP on abating air and water pollution (from Figure I-13). If these expenditures employ about the same percent of the labor force, they generate almost 2 million jobs. These jobs are not all new, nor are they all attributable to federal environmental legislation. And finally, many of the workers would most likely have been employed even in the absence of this legislation.

To analyze the net increase in jobs resulting from environmental expenditures, one has to look at macro-economic studies such as those sponsored by CEQ and EPA. These studies indicate that during a period such as the present when environmental programs are forcing increased expenditures while the nation is suffering unemployment, these programs have a net beneficial impact on employment. The most recent analysis estimates that the unemployment rate in 1976 is 0.4 percent lower with environmental programs than it would have been without them.[380] This means that about 400,000 persons are now employed who would otherwise not be. This positive employment effect can occur only during periods when the country would otherwise be experiencing unemployment. It is expected to disappear as the economy recovers from the recession and as the price increases associated with environmental expenditures begin to have a slight dampening effect on GNP growth, as indicated in Figure I-17. In the long run, however, the programs are not expected to have a significant net adverse impact on employment.

PROBLEMS OF INDIVIDUAL INDUSTRIES

The analyses summarized so far indicate that the macro-economic impacts of our environmental programs are not great enough to cause serious concern. However, one should not conclude that there are no problems. There still are some serious issues concerning the impact of the regulations on specific industries, plants, and firms. For instance, as indicated in Table I-36, some industries are investing a much higher proportion of their total plant and equipment expenditures in pollution control equipment than others.

Last year's Annual Report indicated that the industries most severely impacted have several characteristics in common.[381] They tend to be basic industries, often involved in the processing of raw materials. They also tend to be capital intensive industries, and therefore have suffered from recent high interest rates and difficulties

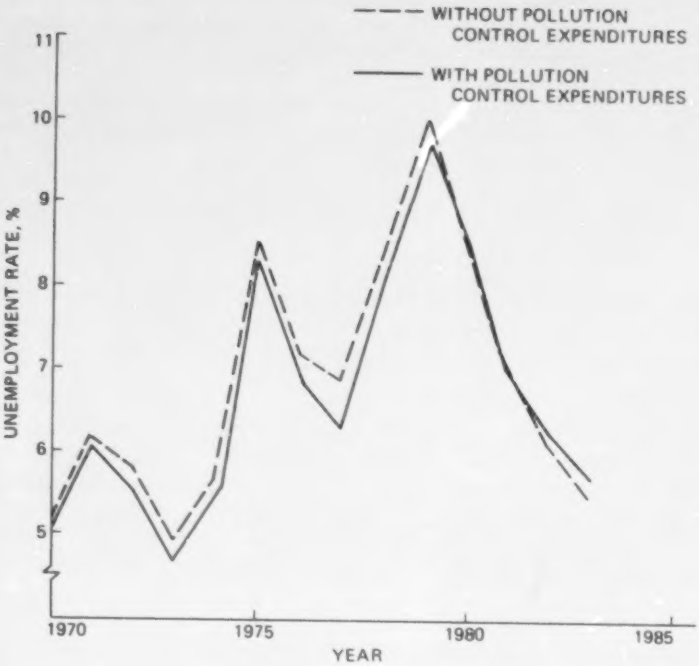


FIGURE I-17. Estimated unemployment rate with and without pollution abatement expenditures

in obtaining equity capital. They are generally energy intensive industries, and therefore have been hard hit by high energy prices.

The following discussion focuses on a few of the problems facing certain industries. The specific industries have been selected not because they are necessarily the most affected (although they are all substantially affected), but because they represent different economic and pollution problems that industries face.

It should be remembered that not all of the micro-impacts of environmental programs are adverse. Some firms are making a profit from elements of their pollution control programs, and a new multibillion dollar industry, described as "one of the relatively few areas of job strength during the recent recession" has grown up to provide the equipment and knowledge required to achieve our environmental goals.[333]

A similarity runs through most of the examples, however, and that is that the smaller firms are the hardest hit. Because there are substantial economies of scale to most pollution abatement processes (particularly when end-of-pipe treatment is used), the average abatement cost for larger firms is much lower than that for smaller firms. Larger firms can also afford to spend more on planning and designing such systems, and therefore have a better chance of adopting the least-cost abatement strategy. Smaller firms can seldom afford to do more than accept "off-the-shelf" equipment. And finally, as mentioned, the larger firms have better access to tax exempt financing, which provides an important subsidy for pollution abatement investments.

Pulp and Paper

The pulp and paper industry is composed of about 400 firms operating more than 600 mills, of which almost 200 are small, old, marginal operations.[383] This industry is also facing financial problems such as rising capital requirements, a high ratio of debt to equity, and a long period of low profit levels.

Pollution problems in the industry are apparent and substantial. Clouds of foul yellow smoke used to surround mills, and tons of smelly wastes entered the rivers. The paper industry accounts for 37 percent of total industrial consumption of fresh water in processing materials.[384] Most of the industry's water use is for processing wood pulp to produce paper and paperboard. The wastewaters contain large loadings of biochemical oxygen demand (BOD), suspended solids, and color, along with small concentrations of such troublesome pollutants as chlorine and mercury.

Most of the industry's water pollution problems can be solved either by treating the wastewater in traditional biological treatment plants or by changing production processes to generate less waste. Several possible process changes that result in less pollution may also result in significant cost savings. The sulfate pulping process is often more economic than the older sulfite process, and generates less water pollution. It is also possible to recycle process water, thus cutting down on the cost both of treating the process water before it is used and of treating the wastewater afterward. Similarly, oxygen bleaching can replace chlorine bleaching with a net decrease in production costs as well as waste load.[385]

These process changes can be incorporated in new plants much more easily than in old ones. Therefore, companies with the capital to expand or renovate are at a comparative advantage. The smaller companies, to the extent that they do not have sufficient capital for replacing or expanding existing facilities, must purchase expensive waste treatment devices for their older plants. In some cases, the cost is prohibitive, forcing individual facilities to close. Many of these facilities are older and are located near urban areas. They are likely to be replaced by newer facilities which will tend to locate closer to the raw materials to the extent that they can do so within the nondeterioration guidelines. One rather perverse aspect of this shift is that as urban mills are closed down or become more expensive to operate, the economics of waste paper recycling are adversely affected.

Whatever approach individual mills use to meet pollution control requirements, the U.S. paper industry is currently allocating 15 percent of its total plant and equipment investment for pollution control, although less than 2 percent of this investment is for process changes.[386]

EPA projects that 2 percent (the NCWQ projected 4.5 percent) of industry capacity may be in jeopardy of closure by 1977 because of water pollution control requirements.[387] Some industry sources argue that the rate of new capacity expansion also may be reduced. The most impacted sector of the industry according to the NCWQ will be the bleached paper mills, especially the small, older single mill firms located in the northeastern and north-central regions of the United States.

Metal Finishing

The metal finishing industry includes establishments engaged in all types of electroplating, plating, anodizing, coloring, and finishing metals and metal products. Compared to most other manufacturing industries, little capital investment (in either plant or equipment) is required. For this reason, most of the firms are small, privately owned shops. It is estimated that more than half of all shops employ fewer than 10 persons.[388] However, little is actually known about the composition and size of the total industry. For example, the number of independent job shops is estimated between 3,400 and 4,000, while the number of "captive" metal finishing shops (those that are part of larger manufacturing entities) is estimated as anywhere from 9,000 to 80,000.[389]

Although the industry faces few air pollution problems, water pollution problems can be serious. The wastewater from such facilities is high in acids and dissolved salts, which are very difficult to remove except with advanced chemical waste treatment systems. Such pollutants can "poison" traditional biological treatment systems, interfering with their proper operation. With present technology, suitable treatment systems are likely to be expensive because the plants, being very small, cannot take advantage of any economies of scale. Efforts to control water pollution problems also may generate additional air and solid waste problems. For example, a plant using an evaporative recovery system to control cyanide discharge may have to invest additional capital for plant ventilation to avoid releasing cyanide emissions to the ambient air. Similarly, the amount of cadmium in the sludge wastes removed from the effluent may create problems if the sludge is disposed of in a sanitary land fill.

The number of dollars that the industries will actually have to spend for pollution abatement is uncertain. EPA has issued effluent guidelines for independent firms; however, it is not clear what guidelines will apply to shops that are part of larger firms. It is also not clear what the costs are of treating the wastes from the metal finishing shops when they are mixed with other plant wastes. In some cases, the treatment systems may have to be set up for the metal finishing shop alone; in others, the treatment system for the whole plant may be capable of handling the metal finishing wastes with no modification and at very little cost. Finally, most shops dispose of their wastes in municipal sewers, but final guidelines have not yet been issued defining what treatment must be given to these wastes before they are released into the municipal system. Some argue that there is very little incompatibility with municipal systems and that very little pretreatment is required; others argue that the waste loads are so incompatible that they must be fully treated.

All of these considerations, combined with the substantial uncertainty regarding the actual number of shops, make it difficult to estimate the abatement costs for the industry or the impacts of the regulations on the industry. Capital requirement estimates have ranged from $2.5 to $28.2 billion in different studies.[390] Some firms claim that immediate investment requirements could be equivalent to anywhere from one-fourth to five times the total value of a firm's capital assets.

Clearly, the probable impacts on the industry are very uncertain; estimates, based on extreme assumptions, suggest that thousands of establishments, primarily small firms, will be forced out of business by water pollution control regulations.[391] The NCWQ estimates that smaller firms face treatment costs (to meet the 1983 standards) eight to nine times higher (per 1,000 gallons of wastes) than the larger firms.[392] The possible plant closure would temporarily reduce the production capacity of this industry by up to 10 percent. However, because of the relatively low capital investment required for entry, the total capacity probably would recover quickly.[393]

Metal finishing provides one of the most extreme examples of the small businessman being hurt by pollution control laws. The total costs of the regulations in this case could be much greater than the actual abatement cost of the firms that remained in business, if for example, the costs in loss of wealth and employment from forced closing of numerous small shops were to be included. The total costs to consumers would include higher product prices resulting from the surviving firms passing through their abatement costs, as well as the reduced choice and availability of services resulting from the possible forced closure of many small, customer-oriented shops.

EPA is currently reconsidering the effluent guidelines for the electroplating industry, and any revisions could substantially affect the expected costs and impacts to the industry. Other important factors that determine the final impact on the industry will be the technology available to meet the standards established by the effluent guidelines, the pretreatment requirements, what effluent guidelines are applied to captive firms, and whether there are technical innovations that can substantially reduce the cost of waste treatment. There is some encouraging news regarding the last factor. Processes are being developed which are claimed to treat some of these wastes at a reasonable investment cost and in such a way that, because of the value of the chemicals recovered from the wastes, this cost will be recovered in a few years.

Electric Utilities [294]

Electric utility companies face problems that are in many ways the opposite of the problems faced by metal finishing plants. The industry is very capital intensive and employs relatively few people. Individual firms are usually large. Each utility has a monopoly in its service area; therefore, the utilities do not compete with one another, and their prices are controlled by state regulatory agencies. The pressures on the industry are particularly intense because the nation is attempting to expand the domestic production of electricity and to save scarcer fuels such as oil. This goal often seems to be in conflict with our environmental programs.

There are approximately 3,000 private and public utility companies. Investor-owned utilities account for 80 percent, and municipal and federal systems each for about 10 percent of capacity. Being capital intensive, utilities recently have had serious difficulties in obtaining capital funds because of the depressed stock market and high interest rates. These financial problems have been made more severe by rapidly increasing prices for oil, coal, and uranium, by rapid inflation in construction costs, and by depressed demand, all of which have contributed to falling profits.

There also has been substantial uncertainty about future demands during the past 2 years. Ten years may be required to bring a generating plant into operation, and there is uncertainty whether demand will increase 20 percent or 100 percent over that period. Efforts at conserving energy may be making the industry's problems more severe because these efforts often seem to affect the kilowatt-hours of electricity consumed (which determines gross income) more than the peak demand for power (which determines the amount of investment required). In brief, investment decisions are becoming more difficult as uncertainties about government policies and market conditions increase.

Utilities have both air and water pollution problems, but four-fifths of pollution abatement costs over the next decade are projected for air pollution control. These costs will fall primarily upon coal-fired plants, about 40 percent of total generating capacity. Initially, the industry responded to air pollution controls by switching to cleaner fuels, especially natural gas and high grade oil. Such switching, however, is now seen as contrary to the nation's energy policy, and some of the same plants that converted to the cleaner fuels to satisfy environmental goals are being forced to switch back to coal to satisfy energy goals.

Expenditures on water pollution control will impact all types of generating facilities. There are two types of water pollution problems:

thermal pollution resulting from the vast amounts of cooling water, and chemical pollution caused by the chemicals added to this cooling water to inhibit vegetation growth on the cooling equipment. This chemical pollution is especially difficult to treat because of the low concentration of chemicals that must be removed from large volumes of cooling water.

The costs of pollution abatement are high, especially in terms of the initial investment cost. With no pollution control devices, a new coal-fueled generating plant costs about $400 per kilowatt (in 1975 prices for a plant to begin operation in 1983). Pollution control requirements can increase this by $6 for thermal pollution control, $1.50 for chemical pollution control, and $60 to $90 for air pollution control.[395] These controls are also expensive to operate, particularly in the energy they consume. A forced draft cooling tower (which has a lower investment cost than a natural draft tower) can use up to 3 percent, and the air pollution control devices can use up to 7 percent of the plant's electrical output.[396]

The various environmental laws have recognized the special situation of utilities and, in some instances, have included special regulations pertaining to them. But utilities still face a substantial burden. An EPA report estimates that electric utilities will have to invest more than $25 billion for pollution control between 1975 and 1985.[394] This investment is larger than that of any other industry, although it is a smaller percentage (10.5 percent) of total plant and equipment expenditures than for other affected industries. This percentage, however, only emphasizes the utilities' basic problem. They face serious difficulty obtaining sufficient capital to satisfy their demand even without pollution control, although regulatory agencies could act to ease these financing problems.

Chemicals

The chemicals industry has been one of the most profitable and fastest growing of American industries over the past three decades. Rapid innovation characterizes the industry; several hundred new chemical compounds are introduced commercially every year.[397] Although there are many large firms in the industry, they do not have as dominant a position as in some other industries. In short, the industry is profitable, innovative and competitive, and does not face as serious economic problems as do many other industries.

However, it does face some substantial pollution problems, especially in its liquid wastes. Because each individual plant has its own unique mix of products (and resulting pollutants), these problems are difficult to regulate. EPA has attempted to write effluent guidelines by product and process, but few plants produce only one product or employ only one process, complicating the application of the different guidelines to a specific plant.

Preparation of the guidelines is also difficult because the nature of the pollution is often not well understood. Chemical companies not only have major problems with the traditional pollutants, such as BOD, suspended solids, and so forth, but also unusual pollutants, and each new chemical can result in a new pollutant type, with unknown effects on humans, wildlife, and water quality.

Traditional treatment methods often do not always apply. In some cases, chemical plants may have to develop their own advanced treatment systems, which can be expensive. Chemical plants are presently spending about 11 percent of their total plant and equipment expenditures on pollution control, and investments for water pollution treatment alone could exceed $9 billion over the next 10 years.[398]

Again, the smaller firms are likely to be most affected. They often cannot use municipal treatment systems because many of the wastes are toxic or they will prevent the effective operation of a traditional biological municipal waste treatment plant. Smaller firms also may not have the technical expertise or available resources to design low-cost pollution control systems oriented toward their specific waste loads.

Larger firms tend to have this expertise and the necessary resources. At least one chemical company has reported that it has been able to realize substantial profits from some of its pollution control investments because of the value of the chemicals recovered in the process.[399] But because each plant is virtually unique, it is impossible to anticipate how widespread such cost savings will be and difficult to predict how seriously the environmental regulations will impact this industry.

Iron and Steel

The iron and steel industry consists of more than 400 plants employing half a million people spread across 37 states. Six states (Illinois, Indiana, Michigan, New York, Ohio, and Pennsylvania) produce almost 75 percent of the industry's output. Industrial profits have suffered during the past decade because of, among other reasons, strong competition from imports. Many of the industry's problems also may have been caused by government policies which have sought to control industry price behavior since 1962, either through jawboning or actual controls.

Environmentally, the industry is confronted by significant air and water problems, although on a plant-by-plant basis the importance of one over the other probably varies considerably. Air pollution problems, which include particulate and gaseous discharges such as SO_x, CO, and HC are easily detected. Fugitive emissions (which escape to the atmosphere directly and not through an exhaust system such as a stack or flue) represent a substantial control problem. In water the industry must control a wide range of pollutants such as suspended solids, phenols, oil and grease, cyanide ammonia, and heavy metals. According to EPA, almost 9 billion pounds of such polluting materials are generated each year, although much of this is already removed before the effluents are discharged into waterways.

In 1975, an estimated 13.5 percent of the industry's total plant and equipment expenditures was used for pollution control. Estimates of total pollution control outlays over the next 10 years range up to $17.0 billion (in 1975 dollars).[400] This could result in 20 to 43 percent of the industry's total annual plant and equipment investment needs during that period being devoted to pollution control.[401] However, the actual level and timing of outlays will depend upon several factors, including the results of industry litigation with EPA and the control strategies that individual states and localities adopt in their state implementation plans to achieve ambient air quality standards.

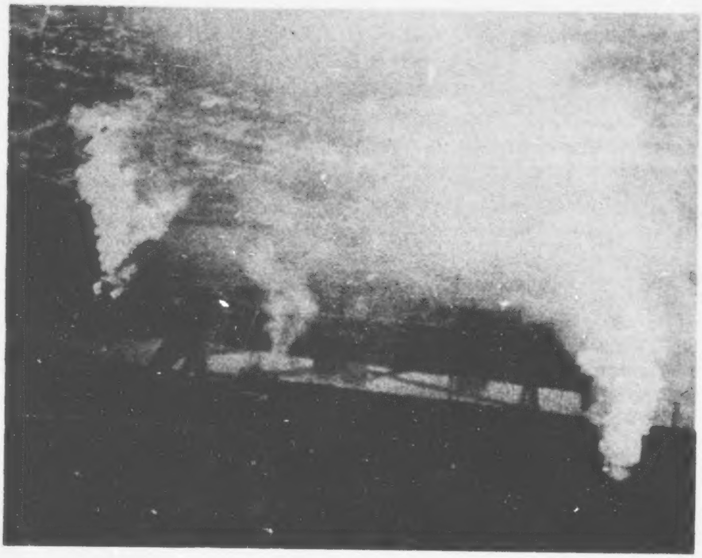
EPA has recognized that one segment of the industry, the several plants located in Ohio's Mahoning River Basin, has special problems. The application of national standards[402] promulgated for the rest of the industry was found to be impractical there because of the potential loss of about 25,000 jobs, or 14 percent of the region's total work force. As a result, those plants will be allowed to meet lower than national requirements for water pollution abatement as least until 1983, although they have received no variances from air pollution control requirements.

The critical problem facing the industry is whether it has the ability to obtain the necessary capital to sustain its own modernization and expansion requirements, and simultaneously meet pollution control requirements. Unlike many other industries, it has in the past depended relatively little on financial markets, relying mostly upon internal cash flows for investment. Because future capital needs seem likely to increase substantially faster than profits, this pattern will have to change.

The severity of this capital problem is most apparent in the short run. Between 1975 and 1977, according to one recent estimate, $3.5 billion of investment is required to ensure compliance with environmental standards.[403] Ninety percent of this total may have to come from external sources, a degree of external financing greater than the industry has undertaken over the last decade for all investment purposes.[403]

Efficiency of Regulations

The examples given indicate that these current pollution control regulations could create substantial economic impacts on individual industries and communities. The severity of the impacts will depend on such factors as the state of the economy, the development of low cost abatement technologies, the stringency of the abatement requirements, and the flexibility that EPA and the state environmental agencies have in implementing environmental control efforts. If na-



This iron and steel plant along the Mahoning River in Youngstown, Ohio, is among several that will be permitted to meet lower than national water pollution requirements. The industry is expected to experience significant economic impacts from environmental regulations because of its considerable water and air pollution problems (Photo credit: U.S. Environmental Protection Agency-Region V, Michigan-Ohio District Office)

tional standards and rapid timetables are rigorously enforced for all emitters, the costs and adverse impacts could be very high. If, on the other hand, there is enough flexibility in setting and enforcing abatement requirements to consider the special characteristics of individual emitters, many unnecessary costs and adverse impacts can be avoided.

But one cannot judge the efficiency of regulations by looking only at potential adverse impacts. Minimum impacts would be achieved with a minimum amount of regulation. Such a policy would not be efficient because it would achieve no improvement in environmental quality. The fact that there are some adverse impacts does not in itself indicate an inefficient program. However, we should be certain that the benefits being achieved outweigh the impacts. In this regard, it is a concern that some recent analyses have indicated that, in some instances, the substantial expenditures being made will bring very little improvement in environmental quality, and the expenditures are often not made in a way that will achieve the most environmental improvement per dollar spent.

A series of studies sponsored by the NCWQ addressed the question of how much water quality could be expected to improve with increasing levels of expenditure. Analyses of the Chattahoochee River in Atlanta, Georgia, indicate that the cost (per pound per day) of BOD removed is about $5,300 in going from present levels of abatement to the 1977 standards, and about $13,000 in going from 1977 to 1983 standards.[404] Achieving the 1977 standards would increase the expected level of dissolved oxygen by about 1 ppm, and achieving the 1983 standard by another 0.3 ppm. Because there are no plans to deal effectively with stormwater runoff, even in 1983 the river quality could degenerate to zero dissolved oxygen for "an extended period of time" with substantial impacts on the river's ecology.[405]

A further analysis of the efficiency of the present water quality program was provided by the Study Committee on Water Quality Policy of the National Academy of Sciences.[406] By using an admittedly simplified computer model, they compared the cost of the present pollution control strategies with possible alternative strategies. For instance, a strategy which, instead of requiring uniform application of effluent standards, achieved the same reduction in residuals by concentrating abatement where it was least costly would save 40 percent of the capital costs required to meet the 1977 standards, and 30 to 35 percent of the total capital costs required to meet the 1983 standards.[406]

Few would argue about the desirability of achieving the same accomplishments as under our present system, at substantially less cost. But any suggestion that existing policies be modified also raises serious questions. Is it feasible to change the existing system, which has still not been fully implemented after 4 years, without causing further administrative confusion and delaying the attainment of our environmental goals? Are there not questions of fairness in adopting a system that requires more abatement by some and less by others, when the degree of effort required would only vaguely be related to the amount of pollution generated or the polluter's ability to pay the costs? And, most fundamentally, can we design and efficiently implement a system that would be sufficiently sensitive to the particular characteristics of individual polluters and local environments and bring about the potential gains in efficiency, without establishing an unduly expensive and burdensome bureaucratic process or creating unreasonable delays in attaining our environmental objectives?

All of these questions are relevant to the existing system as well as any possible modifications. The current environmental laws reflect a strong frustration with the very slow (or often lack of) progress in environmental improvement under earlier, more flexible, pollution control laws. But we must continuously ask whether further improvements are possible. Our economy cannot afford to spend resources where they do no good—there are too many other needs that have to be met. Unfortunately, because our recent pollution control legislation has stressed that everyone clean up the same amount with little regard to efficiency considerations, much of the analysis needed to answer the questions raised above has been left undone. Many observers are becoming convinced that we cannot afford to delay these analyses any longer; that we have to make sure that every dollar we spend on improving environmental quality is being spent in the most effective way; and that the benefits we get are at least worth the amount that we are spending.

APPENDIX: ABATEMENT COST ESTIMATES

The method for estimating pollution abatement costs is generally the same as in previous years.[407] This year's estimates cover the decade 1975 through 1984 and are given in 1975 dollars. Changes in the estimating period and the shift from 1974 to 1975 dollars account for most differences between estimates for last year and those of this year. Otherwise, the major changes have been made in estimating costs of mobile source air pollution, municipal wastewater collection and treatment, and solid wastes. Adjustments also have been made in estimates for several industries and for the electric utility sector on the basis of recent studies completed by EPA.[408]

Mobile source estimates have been reduced to reflect the expected relaxation of standards as a result of proposed amendments to the Clean Air Act. The EPA proposal of March 1975 was adopted for the calculation (see Table I-1 of this chapter).

An improved computational procedure was used to estimate municipal sewage treatment costs. The Bureau of the Census has adopted a new survey procedure to determine investment in public sewage facilities.[409] Results indicate that the rate of investment is more than $1 billion a year higher than previously thought. This is the primary reason that the total investment and the capital cost estimates have been increased. This year's computations also indicate that operation and maintenance costs are likely to be higher than previously estimated.

The procedure for estimating solid waste costs has been changed to make it compatible with the procedure used by the Bureau of Economic Analysis.[410] For the first time, this year's estimates include costs of collecting and disposing of solid wastes by industries (excepting mining and electric utilties).

Estimated incremental abatement costs are presented in Table I-36, and estimated total costs in Table I-37.

TABLE I-36. Investment for pollution control by U.S. industries (Source: U.S. Department of Commerce, Bureau of Economic Analysis)

Industry	Reported expenditures: 1975				Pollution control as a percent of total plant and equipment investment		
	Total	Air	Water	Solid waste	Actual 1974	Actual 1975	Planned 1976
All industries	**6,549**	**3,790**	**2,362**	**396**	**5.0**	**5.8**	**6.1**
Manufacturing	**4,475**	**2,494**	**1,736**	**245**	**8.0**	**9.3**	**8.9**
Durable goods	1,775	1,161	529	85	7.3	8.1	7.9
Primary metals	1,012	750	221	41	16.6	17.2	17.3
Blast furnace steel works	396	261	135	1	12.1	13.5	18.8
Nonferrous metals	546	425	82	39	21.8	24.1	18.8
Electrical machinery	136	34	93	9	6.8	5.8	6.6
Machinery, except electrical	83	40	37	6	1.8	1.8	2.2
Transportation equipment	116	51	50	15	3.7	3.4	4.1
Motor vehicles	86	35	38	13	4.1	3.9	4.8
Aircraft	26	14	11	1	2.9	2.8	2.8
Stone, clay, and glass	198	164	31	3	12.9	14.3	11.5
Other durables	229	122	97	10	4.5	5.3	4.3
Nondurable goods	2,700	1,333	1,208	160	8.7	10.3	9.6
Food including beverage	175	71	92	12	4.7	5.2	5.4
Textiles	31	15	15	1	3.3	4.6	5.8
Paper	489	273	189	27	19.3	16.8	15.0
Chemicals	684	250	394	40	0.3	10.9	11.5
Petroleum	1,239	684	483	72	10.1	11.8	9.8
Rubber	41	25	14	2	3.2	4.0	4.6
Other nondurables	41	14	22	6	1.8	2.8	2.6
Nonmanufacturing	**2,074**	**1,296**	**626**	**152**	**3.0**	**3.2**	**4.1**
Mining	73	32	31	10	1.8	1.9	2.7
Railroad	35	11	21	3	2.2	1.4	1.5
Air transportation	11	6	4	1	0.7	0.6	1.1
Other transportation	41	12	19	10	2.3	1.4	2.1
Public utilities	1,700	1,138	466	96	7.9	8.4	10.1
Electric	1,650	1,123	438	89	8.9	9.7	11.9
Gas and other	50	16	28	6	1.5	1.5	1.1
Communication, commercial, and other	214	97	84	33	0.6	0.6	0.6

TABLE I-37. Estimated total pollution control expenditures (in billions of 1975 dollars): 1975-1984 [a]

Pollutant/source	1975			1984			Cumulative (1975-1984)			
	Operation and maintenance costs	Capital costs [b]	Total annual costs [c]	Operation and maintenance costs	Capital costs [b]	Total annual costs [c]	Capital investment	Operation and maintenance costs	Capital costs [b]	Total annual costs [c]
Air pollution										
Public	0.1	0.1	0.2	0.6	0.2	0.8	1.9	4.2	1.8	6.0
Private										
Mobile	3.4	1.5	4.9	1.3	4.4	5.7	29.0	20.9	31.7	52.6
Industrial	2.1	2.4	4.5	4.9	5.6	10.5	24.0	34.8	39.5	74.3
Utilities	1.0	1.0	2.0	3.5	3.5	7.0	19.6	21.0	21.0	42.0
Subtotal	**6.6**	**5.0**	**11.6**	**10.3**	**13.7**	**24.0**	**74.0**	**80.9**	**94.0**	**174.9**
Water pollution										
Public										
Federal	0.2	<0.05	0.2	0.2	0.1	0.3	2.0	2.1	0.4	2.5
State and local	2.3	7.6	9.9	6.2	15.1	21.3	56.9	41.7	113.7	155.4
Private										
Industrial	1.9	1.7	3.6	7.4	5.7	13.1	41.4	40.6	33.0	73.6
Utilities	0.6	0.4	1.0	1.4	0.8	2.2	3.8	10.5	6.3	16.8
Subtotal	**5.0**	**9.7**	**14.7**	**15.2**	**21.7**	**36.9**	**104.1**	**94.9**	**153.4**	**248.3**
Radiation										
Nuclear powerplants	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.2	0.1	<0.05	0.2
Solid waste										
Public	1.5	0.3	1.8	2.1	0.6	2.7	4.6	18.2	4.2	22.4
Private	2.9	0.7	3.6	3.9	1.1	5.0	5.6	28.4	8.8	37.2
Subtotal	**4.4**	**1.0**	**5.4**	**6.0**	**1.7**	**7.7**	**10.2**	**46.6**	**13.0**	**59.6**
Land reclamation										
Surface mining [d]										
Noise	**NA**	**NA**	**NA**	**0.3**	**0.3**	**0.6**	**1.7**	**1.8**	**1.6**	**3.4**
Total	**16.0**	**15.7**	**31.7**	**31.8**	**37.4**	**69.2**	**190.0**	**224.2**	**262.0**	**486.2**

[a] Incremental costs are expenditures made pursuant to federal environmental legislation beyond those that would have been made in the absence of this legislation.

[b] Interest and depreciation.

[c] Operation and maintenance plus capital costs.

[d] Not included in this year's estimate.

NA = not available.

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TRENDS

II. CONDITIONS AND TRENDS

Some of the Council's primary responsibilities are to gather, analyze, interpret, and report timely and authoritative information concerning the nation's environmental conditions and trends. To meet the growing need for environmental information, CEQ has increased activities in the areas of environmental indicators, data analysis, and the evaluation of monitoring programs.

In this chapter we first discuss trends in the development and application of energy resources and technologies, which CEQ is directed to evaluate under the Federal Nonnuclear Energy Research and Development Act of 1974. We then address air and water quality conditions and trends, including some new types of indicators and analyses generated by UPGRADE (User Prompted Graphic Data Evaluation), the Council's recently developed environmental data analysis system.

A new type of presentation is used in this chapter to describe population growth trends in nonmetropolitan areas and in two important categories of natural resources: timber and minerals. This type of presentation combines a considerable amount of information in a comprehensive and systematic format that reveals interrelationships among causative factors. The format is taken from CEQ's forthcoming publication *Environmental Quality Indicators, 1976.* This book, best described as a national "briefing" document, uses graphic indicators to provide policymakers and the general public with an overview of environmental conditions and trends.

ENVIRONMENTAL CONSEQUENCES OF ENERGY TECHNOLOGY

Energy production and use are perhaps the most important determinants of environmental quality. Choices we make today in developing energy systems for the future will powerfully affect environmental conditions for decades to come. Conversely, environmental factors are major considerations in judging the acceptability of future energy systems.

Section 11 of the Federal Nonnuclear Energy Research and Development Act of 1974 directs CEQ to report annually on the probable environmental consequences of trends in the development and application of energy technologies.[1] This section is our second response to that mandate.

We are in the early stages of a transition from primary reliance on domestic petroleum and natural gas to alternative energy sources. U.S. production of both fuels has begun to decrease.[2] With effort and luck, production declines may be halted or even reversed for 1 or 2 decades, but as we approach depletion of our newly developed nonrenewable resources, production will again begin to drop.[2] Some combination of coal and nuclear power is expected to be used increasingly in place of oil and gas for the rest of this century. The dominant energy sources for the 21st century are yet to be determined.

There are substantial uncertainties in making the transition to new energy systems. All options—nuclear, coal, solar, geothermal, and others—present technical and economic question marks. Environmental understanding is still more limited, in many cases almost nonexistent. *In the Council's view, elucidation of the health and ecological effects of energy technologies is a matter of high national priority.*

The factors that will influence the environmental consequences of trends in the development and application of new energy technologies are complex and interrelated. The following discussion concentrates first on what, in the Council's view, are the major determinants of these consequences: overall energy demand, how the energy is produced and utilized, and the ability to understand health and ecological effects and to develop workable controls. This year's report examines possible implications of the application of new coal conversion technologies by discussing the economic, environmental, and energy efficiency factors that might influence trends in coal technologies, and highlights major environmental issues that must be addressed. Future Annual Reports will continue to evaluate these causative factors and will review the environmental effects of other technologies.

FACTORS INFLUENCING ENVIRONMENTAL CONSEQUENCES

Energy Supply and Demand

Gross Energy Consumption. National energy consumption is perhaps the most important factor governing the adoption of the new energy technologies and the environmental consequences that follow. It depends on such factors as national income, total population and its age distribution, fuel prices, level and mix of demand for goods and services, and the overall efficiency of our energy systems.

Figure II-1, shows U.S. energy use has grown considerably since 1900. Annual per capita energy consumption increased from roughly 100 million British thermal units (Btu) in 1900, to about 200 million Btu in 1950, and to more than 300 million Btu in 1970.[3] From 1900 to 1975, U.S. population increased less than threefold, while national energy consumption increased by about a factor of seven.[4]

Demand estimates for national energy consumption in the year 2000 range from about 100 quadrillion Btu (qBtu) to 190 qBtu; this compares with a 1975 consumption of about 71 qBtu (see Figure II-1).[5] There seems to be a consensus that historic energy growth trends will not continue in the longer term.[5] As noted in the Energy section of Chapter I, energy demand dropped by 5 percent between 1973 and 1975. In the first half of 1976, however, U.S. energy demand increased over 1975 levels.[6] Although growth is considered likely to continue, it may be at a slower rate than in the past, with the result that energy consumption in the year 2000 will be near the lower end of the range of estimates. It is beyond the scope of this discussion to examine in detail the many approaches to the conservation of nonrenewable energy resources and the more efficient use of energy; these are discussed in various publications.[7]

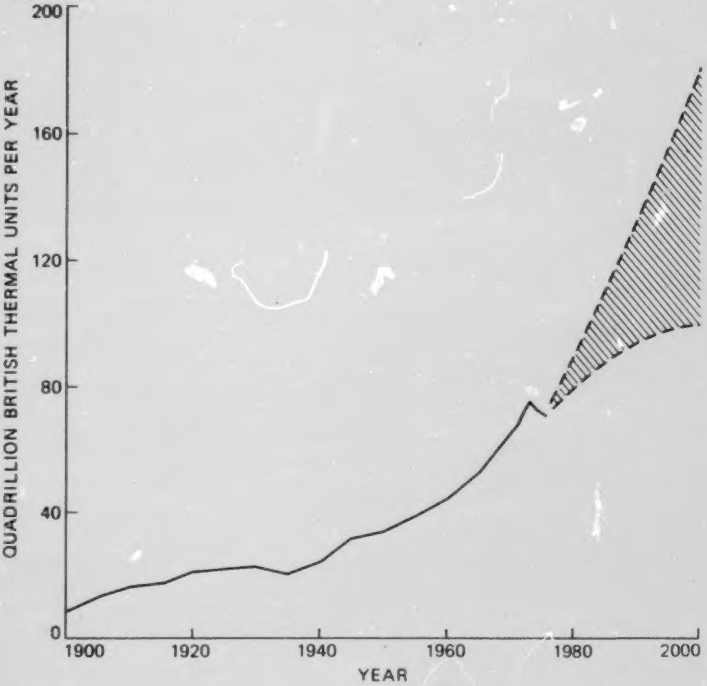


FIGURE II-1. U.S. gross energy consumption for 1900-1975 and range of projections to the year 2000 [3,4,5]

TABLE II–1. Environmental effects inventories and total energy consumption for Reference Energy Systems[a, 8]

Year	1972	1980	1985	1990	2000	2020
Total gross energy consumption, quadrillion Btu (q Btu)	72.2	90	107	123	163	279
Centralized air pollutants[b]						
Carbon dioxide (CO_2) 10^8 tons	15	18	20	22	26	49
Carbon monoxide (CO), 10^6 tons	0.2	0.2	0.3	0.3	0.4	0.8
Nitrogen oxides (NO_x), 10^6 tons	3	6.1	6.9	7.4	8.8	16
Sulfur dioxide (SO_2), 10^6 tons	15	15	13	10	5	9
Particulates, 10^6 tons	6.9	7.1	7	6.3	5	9.3
Hydrocarbons (HC), 10^6 tons	1.6	1.6	1.7	1.7	1.9	3.2
Aldehydes, 10^3 tons	28	25	24	23	20	23
Decentralized air pollutants[b]						
CO_2, 10^8 tons	30	36	40	44	53	69
CO, 10^6 tons	107	40	21	20	20	26
NO_x, 10^6 tons	20	17	22	20	26	34
SO_2, 10^6 tons	4	5.3	6.7	7.7	9.9	13
Particulates, 10^6 tons	91	56	78	88	114	144
HC, 10^6 tons	143	65	54	60	72	94
Aldehydes, 10^3 tons	254	348	408	472	577	758
Total air pollutants						
CO_2, 10^8 tons	45	54	60	66	79	118
CO, 10^6 tons	108	41	21	20	20	27
NO_x, 10^6 tons	24	24	29	28	34	50
SO_2, 10^6 tons	20	20	20	18	15	22
Particulates, 10^6 tons	48	63	85	94	119	153
HC, 10^6 tons	145	66	56	62	74	97
Aldehydes, 10^3 tons	282	373	433	494	598	781

Water pollutants (all in 10^{3} tons)						
Bases	14	16	23	26	36	68
Nitrates	0.2	1.5	3.2	5.2	11	28
Other dissolved solids	840	960	1,200	1,300	1,600	3,100
Nondegradable organics	91	105	112	114	110	130
Biochemical oxygen demand (BOD)	45.5	59	68	77	88	118
Chemical oxygen demand (COD)	116	171	192	214	256	338
Radioactive effluents						
Solids, 10^{3} cubic feet	1.3	9.8	21	35	77	190
Krypton-85, 10^{6} curies	6.4	47	102	170	370	914
Tritium, 10^{6} curies	2.3	16.9	36.7	60.8	133	328
Population exposure, 1000 man-rem	7.1	52	114	188	411	1,014
Liquids, 10^{6} gallons	132	979	2,120	3,520	7,690	19,00
Heat dissipated						
Central sources, q Btu	13	18	24	29	46	98
Decentralized, q Btu	60	72	83	94	117	181
Solid waste, 10^{6} tons	124	198	278	342	501	1,020
Land use, 10^{3} acres	14	17	22	26	36	71
Occupational health and safety						
Deaths	978	1,295	1,659	1,898	2,483	4,530
Injuries, thousands	19	25	32	38	51	95
Person-days lost, thousands	1,395	1,801	2,306	2,680	3,556	6,478

[a] Data rounded for clarity.

[b] Centralized atmospheric emissions generally involve electrical generating plants and are typically distributed over large areas of varying population density. Decentralized emissions from automobiles, home heating units, etc., are generally released near ground level in quantities proportional to the population density.

Table II-1 lists the environmental pollutants for selected years calculated by Brookhaven National Laboratory's "Reference Energy System."[7] The specific assumptions are detailed in a report by the National Center for the Analysis of Energy Systems.[8] Generally, the Reference Energy System is based on existing technology, and thus does not reflect the environmental benefits associated with major efforts to use energy more efficiently and substitute alternative technologies. However, regulations presently scheduled to come into effect to control unit emissions from automobiles and central station powerplants are incorporated.

The results clearly show the environmental benefits of slowing the growth in energy demand and substituting technologies that have less adverse environmental impacts. If such efforts are not effective, these calculations suggest that levels of many pollutants will increase sharply. For example,

- Total air pollutants
  - Carbon dioxide
  - Nitrogen oxides
  - Particulates
  - Aldehydes
- Water pollutants
  - Bases
  - Nitrates
  - Other dissolved solids
  - Biochemical oxygen demand
  - Chemical oxygen demand
- Radioactive effluents

The environmental benefits of slower energy growth cover a wide range: for example, better air quality, less land disturbed for strip mining, fewer oil spills, less radioactive waste to manage.[9] Slower growth means less reliance on costly, environmentally risky supply options, and helps to provide time for developing acceptable alternative sources.

Less obvious, and more controversial, are the economic and social costs that might be associated with a low energy growth future. There is evidence, however, that energy growth and economic growth are not inextricably linked. The extent to which the ratio of U.S. energy to Gross National Product (GNP) has varied is shown in Chapter I, Figure I-8. Moreover, rising resource costs and more energy efficient technologies could markedly "decouple" the energy/GNP relationship.[10]

Comparisons with other countries underscore the same point. Although differences in geography, demography, and economic structure make international comparisons difficult, recent studies show that several countries have a per capita GNP similar to ours, but that energy consumption per capita is significantly lower. Figure II-2 shows comparative GNP and energy use for several countries.[11]

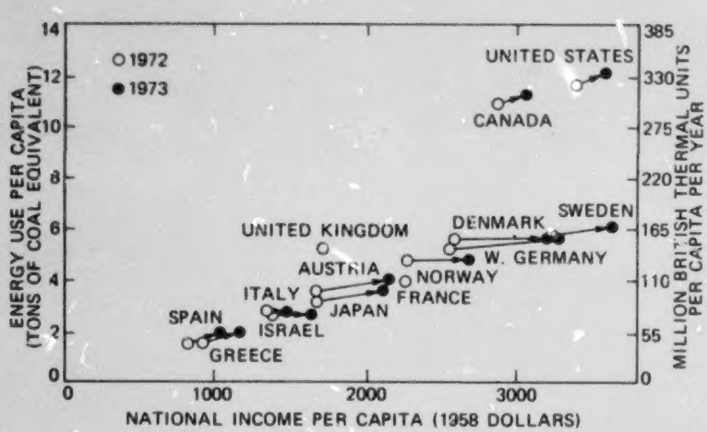


FIGURE II-2. Comparison of national income per capita with total energy use per capita for selected countries [11]

A recent study makes detailed comparisons between per capita energy consumption in the United States and Sweden.[12] The tentative conclusions suggest that (when corrected for climate, electric losses, and energy embodied in foreign trade) Swedish methods of energy conservation would result in a saving of about 30 percent of the total energy used in the United States. More analysis is needed to explore rigorously the relationship between economic growth and energy growth, and to illuminate the tradeoffs involved in sharply reduced energy growth or even zero energy growth.

Energy Supply and Use Patterns. Patterns of energy supply also play an important role in determining environmental consequences. At a given level of energy consumption, environmental effects depend in large measure on the details of how the energy is supplied and used.

Questions with an important bearing on supply patterns include: How long can U.S. oil and natural gas production remain near current levels? How rapidly can coal and nuclear energy production be expanded? How serious are the health, safety, and ecological problems of coal and nuclear energy? How successful are R&D programs for new or modified sources of energy?

Research, development, and demonstration (RD&D) is proceeding on such energy technologies as solar and geothermal energy, coal conversion, nuclear fusion, and the Liquid Metal Fast Breeder Reactor. Each of these technologies has its own specific environmental consequences. As noted in Chapter I, solar energy could supply a sizable fraction of total U.S. demand by the year 2000. The potential environmental problems associated with solar energy are thought to be less severe than those associated with more conventional sources.[13]

There also may be some potentially important shifts in the way energy is used. Figure II-3 shows an energy supply pattern that is typical of many recent estimates. A striking change is projected in

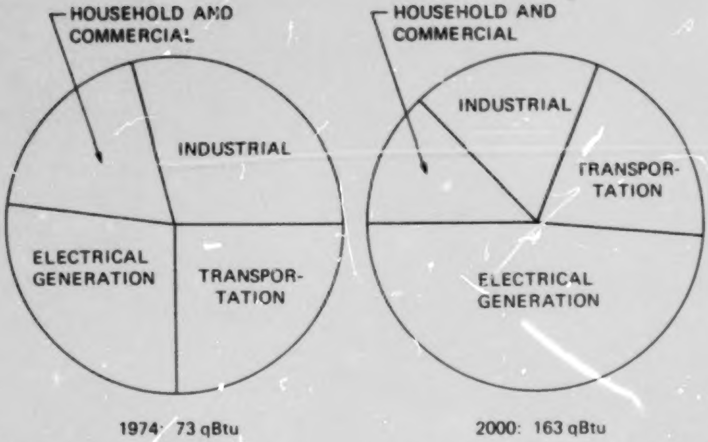


FIGURE II-3. U.S. energy consumption in quadrillion British thermal units: 1974 and 2000 (projected). Figure assumes that synthetic fuels are distributed among the consuming sectors in the same ratios as their nonsynthetic counterparts (based on estimates from U.S. Department of the Interior)

the electrical generation sector. By the year 2000, about 50 percent of the nation's gross energy inputs may be going into this sector, compared with a current figure of about 25 percent. It is uncertain whether or not such a pronounced shift toward electrification of our energy system would have on balance a desirable effect.

If, as Figure II-3 suggests, electrical energy consumption increases more than fourfold by the year 2000, the number of nuclear powerplants might increase as much as tenfold.[14] Similarly, western coal production [15] and water requirements linked with it might also increase by a factor of more than 10. Changes of such magnitudes would require hundreds of new powerplants, thousands of extra miles of transmission lines, and hundreds of new coal mines and coal conversion plants. Figures II-4 and II-5 show the increases that may occur in the generation facilities for electric power.[16] The water demands for coal conversion facilities and powerplants, particularly in the West, could exceed the available supply. Even with improved pollution control systems, the impacts of such "scaleups" could be severe.

Conversion from fuel to electricity involves substantial energy losses. (Roughly two-thirds of a powerplant's fuel energy emerges as waste heat.) Furthermore, a proliferation of transmission lines crisscrossing the country would create aesthetic and environmental problems.[17] Improved transmission line design,[18] better use of the "waste" heat either from or for electrical generation,[19] and increased end use efficiency (e.g., widespread use of improved heat pumps) could reduce the problems, but there is still reason for concern about the scaleup.

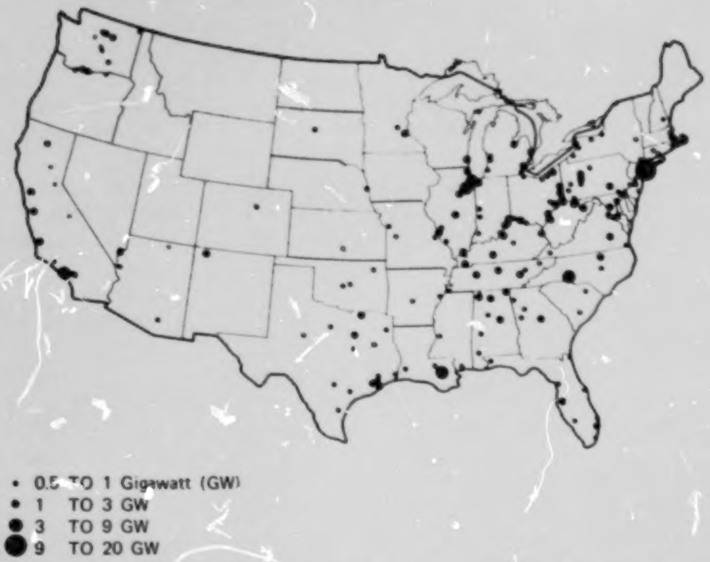

• 0.5 TO 1 Gigawatt (GW)
• 1 TO 3 GW
● 3 TO 9 GW
● 9 TO 20 GW

FIGURE II-4. Electrical generation for the conterminous United States: 1970 (Source: U.S. Federal Power Commission)

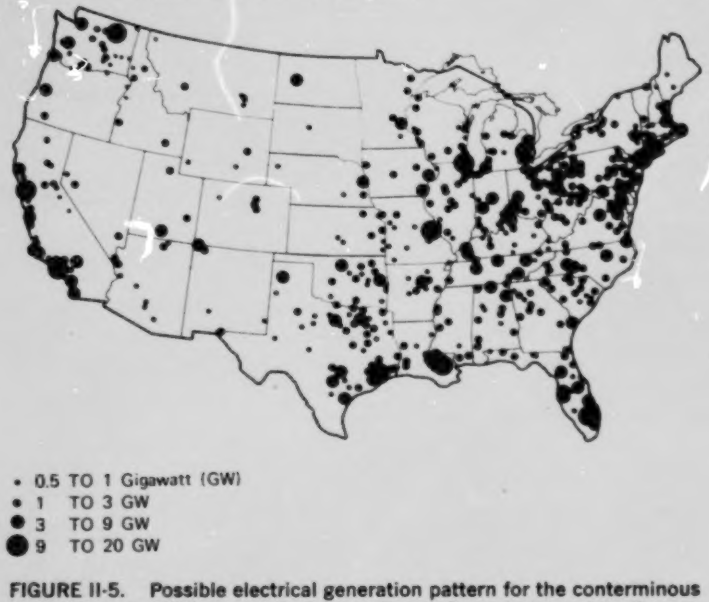

• 0.5 TO 1 Gigawatt (GW)
• 1 TO 3 GW
● 3 TO 9 GW
● 9 TO 20 GW

FIGURE II-5. Possible electrical generation pattern for the conterminous United States: 2000. The U.S. Federal Power Commission originally suggested this pattern for 1990; we have assumed this same pattern for the year 2000, based on the slower growth rate expected for electrical power consumption (based on data from U.S. Federal Power Commission)

Peak Demand Factors. Many environmental impacts depend not only on total annual energy consumption and supply/use patterns, but also on how demand varies with time. Peak demand for electricity determines the number of new powerplants required; the extra lines, if any, necessary to transmit the peak demand; and the quantity of pollutants emitted to the environment at peak times. In the same way, the road capacity that cities need depends more on peak demands during rush hours than on the average number of vehicles on the street, spread out over the day. Measures to flatten the peak demands of energy-using systems can reduce environmental impacts and also economic costs.[11] Load leveling can be accelerated by adjusting the electrical rate structure and applying direct load management techniques. Utility rate structures have not generally differentiated between on-peak and off-peak usage, despite the fact that it is the former which forces the additional costs of capacity expansion. Direct load management techniques include such approaches as time-controlled water heating, heat storage systems, and "load shedding" devices that turn off selected equipment for short periods when the system's maximum load is being approached.[20]

Environmental Understanding

The social and environmental costs of energy systems include a wide range of concerns, such as public health, occupational health and safety, environmental diversity, and social stability. These concerns have led to a variety of methods for measuring impacts and costs. Three broad categories of criteria can be used to characterize the impacts of energy technology: criteria that are quantifiable and amenable to comparison among different technologies; criteria that are quantifiable, but difficult or impossible to compare among alternative technologies; and criteria that are difficult or impossible to quantify even for a single technology.[21] Table II-2 lists some of the most important criteria, arranged according to this scheme; indices that provide a quantitative measure are also listed.

Environmental Controls. The severity of environmental impacts depends critically on effectiveness of government regulations (see discussion in Chapter I) and the technological developments necessary to implement regulations. Our understanding of the health and ecological effects of present energy systems is barely sufficient for setting ambient air quality and emissions standards for only a few of the pollutants associated with energy technologies, e.g., sulfur dioxide, carbon monoxide, and particulates. Reasonably detailed ambient and emissions data exist for only a few pollutants; even for these pollutants, actual health and ecological effects are still being determined.[21]

New energy technologies may also produce harmful pollutants quite different from those generated by present technologies. Identifying them early in the development stage and developing means to control them before the technology comes into wide use are highly

TABLE II-2. Some criteria for evaluating impacts (indices follow colons)*

- **Quantifiable, readily comparable**
  - **Deaths: number, days of life lost**
  - **Accidents, illnesses: number, days of productive activity lost**
  - **Damages to economic goods and services: dollars**
  - **Use of land, water, energy: square meters, liters, joules**
  - **Material effluents: kilograms (of the same substance)**
  - **Nonmaterial effluents: joules, decibels**
  - **Dollar costs of reducing quantifiable impacts by specified degrees**
- **Quantifiable, difficult to compare**
  - **Use of nonfuel minerals: kilograms (of different substances)**
  - **Material effluents: kilograms (of different substances), curies**
  - **Magnitude of perturbation in a natural process: dimensionless fraction**
  - **Spatial and temporal distribution of harm: area, time**
- **Difficult or impossible to quantify**
  - **Aesthetic damage**
  - **Degree of irreversibility of harm**
  - **Degree of risk**
  - **Degree of voluntarism of risk**
  - **Degree of coincidence of risks and benefits**
  - **Quality of evidence of harm**

***Based on reference 21.**

important to the protection and improvement of environmental quality. Early identification should also lead to the modification of technologies earlier in the RD&D process to make them more environmentally acceptable. As more is learned about the impacts of energy systems on the quality of our air, land, and water, new standards in the protection of public health and welfare can be expected and current pollution standards may be adjusted. Even so, if gross energy consumption increases, maintaining a given level of environmental quality may become increasingly difficult from both a technological and economic standpoint.

Even though control technologies are improving, at least part of the improvement will be negated if expected increases in energy consumption materialize. Ambient levels could begin to increase for some pollutants. Figure II-6, drawn from the *Project Independence Report*, indicates that, by 1985, ambient levels of sulfur dioxide and particulates may increase over 1972 levels for large parts of the eastern United States and in some regions of the West.[22]

Pollution control obviously exacts costs, which include both increased capital expenditures and extra energy for pollution control equipment. Ultimately, a social judgment must be made as to whether the costs are acceptable. The degree of improvement in these control technologies can be judged in part by the extent to which the costs of control are reduced. There are limits on the extent to which these control technologies can be improved and their costs reduced. An important consequence may be that technologies posing a significant environmental risk that is expensive to control will not come into widespread use.

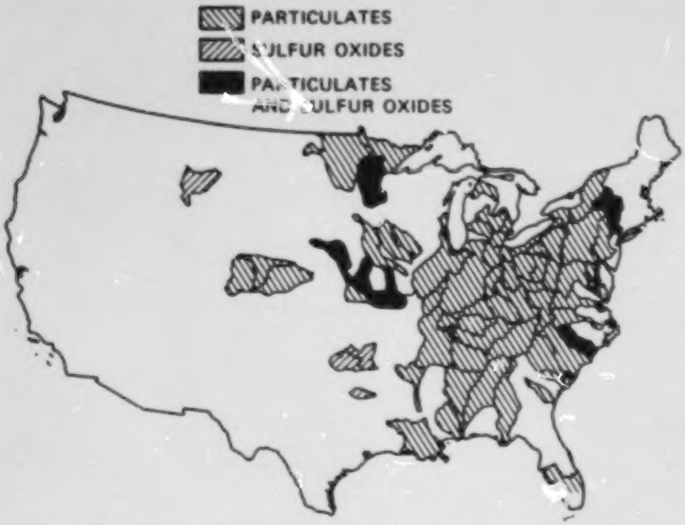


FIGURE II-6. Regions exceeding primary standards in 1972 and possibly increased loadings in 1985 for sulfur oxides and particulates as suggested in the Federal Energy Administration's Business-as-Usual Scenario (Source: U.S. Federal Energy Administration) [22]

Risks from Nonroutine Events. So far, we have considered routine impacts from energy systems, that is, the air, water and thermal pollution expected during routine operation. We must also consider nonroutine impacts, that is, the consequences of a very serious event or system failure, which has a very small but non-zero probability of occurrence.

Several of our present energy supply systems have the potential for low-probability, high-consequence accidents. For example, a major spill from offshore oil production or a tanker accident could damage marine ecosystems and severely disrupt fishing, tourism, and other human activities over a period of years.[23] The most closely examined case is the possibility of a major accident at a nuclear powerplant.[24] Another example is the possibility of a large fire at the spill site after a liquefied natural gas tanker accident.[25]

The potential for large-scale climatic change due to increased energy consumption is of considerable concern to some scientists.[26] The atmospheric buildup of carbon dioxide and small particles, both of which are linked to the burning of fossil fuels, could conceivably change the global climate.

Our uncertain ability to predict large-scale nonroutine events such as these adds to the complexity of evaluating environmental consequences of energy technologies that are candidates for development. Yet the possibility of such events cannot be ignored in a comprehensive evaluation.

COAL CONVERSION TECHNOLOGIES

Coal is expected to play a vital role in our mid-term energy future, that is at least until the end of the century. Efforts to increase the use of coal in existing facilities, and to foster research and development for new uses are receiving high priority.[27] We have therefore chosen to focus this year's energy trends discussion on coal technologies.

Coal is the most plentiful of our fossil fuels, and accounts for about 85 percent of the nation's remaining fossil energy resource base.[28] It is the only currently usable fossil energy resource we are certain to have in some abundance over the longer term. At current consumption levels, we have enough coal reserves to last 300 years.[28] If coal consumption levels were to grow at 3 percent per year, our reserves could last about 80 years. Projections of the nation's coal consumption vary widely. Estimates for annual U.S. coal production at the turn of the century range from 1.4 times to more than 5 times the current level.[29] In some regions production may increase even more.

From the environmental standpoint, coal is the most difficult fossil fuel (excluding oil shale—discussed in last year's Annual Report, pages 426-439). There have been severe health, safety, and ecological problems associated with its mining and use.[30] Intensive efforts are being directed toward reducing these impacts and developing alternatives to direct combustion of coal.[31]

Coal RD&D Programs

New coal technologies now under development promise two highly important benefits: first, to reduce the sulfur oxide and particulate pollution characteristics of direct burning of coal; second, to provide liquid and gaseous fuel substitutes for domestic oil and gas production. Both of these capabilities are important to the well-being of the nation. However, information on these developing technologies is not yet adequate to permit confident comparisons with other energy systems on overall environmental impacts. There is also considerable uncertainty as to their technical and economic feasibility.

Coal-based energy technologies may be divided into two categories: direct coal combustion (conventional, conventional with desulfurization, and fluidized bed combustion, FBC) and fuel-to-fuel conversion (coal gasification and coal liquefaction). Emphasis has begun to shift from conventional combustion toward alternatives that can reduce the amount of some of the pollutants released into the atmosphere, most notably the oxides of sulfur (see Table II-3).

Coal can be desulfurized, even when it is burned directly, by processes that remove sulfur either before or after combustion. Techniques for prior removal include both physical and chemical methods. Widespread application of such techniques could reduce sulfur

TABLE II-3. Coal conversion and combustion processes receiving federal support[a]

Process	Development scale	Size	Environmental data
Coal cleaning			
Meyers Chemical Cleaning (TRW/EPA)	Pilot	750 PPH	Some
Physical Cleaning Test Facility (EPA/Bureau of Mines)	Pilot	480 TPD	None
General Public Utilities	Commercial	1200 MW	None
EPA Test Support	Commercial	650 MW	None
Fluidized bed combustion			
Atmospheric bed (PER)	PDU	Unk	Some
	Pilot	30 MW	NA
CPU-400, gas turbine (CPC)	PDU	1 TPD	None
Pressurized FBC (Esso)	Unk	Unk	Some
Pressurized bed (IEA)	Pilot	30 MW	None
Pressurized FBC (NRDC/BCURA)	Pilot	Unk	Unk
High-Btu gasification			
Bi-gas (BCRI)	Bench	1 TPD	Some
	Pilot	120 TPD	NA
Methanator section	PDU	Unk	Unk
Clean fuels (Coalcon)	Demo	2600 TPD	Unk
Hydrocarbonization (Union Carbide)	PDU	20 PPH	Unk
CO_2 acceptor (CONOCO)	Pilot	40 TPD	Some
Hydrane (Bureau of Mines)	Bench	12 PPH	Some
	Pilot	25 TPD	Unk
Hygas (IGT)	Pilot	75 TPD	Unk
Liquid phase methanation (Chemical Systems)	Pilot	2 MM SCFD	Unk
Synthane (Bureau of Mines)	PDU	40 PPH	Some
(Lummus)	Pilot	75 TPD	NA
High- and low-Btu gasification			
Ash agglomerating (Battelle/Union Carbide)	Pilot	25 TPD	Some
Ash agglomerating (IGT)	PDU	500 PPH	None
	Pilot	250 TPD	NA
Low-Btu gasification			
Boiler fuel gas (Westinghouse)	PDU	12 TPD	Some
	Pilot	120 TPD	NA
Boiler fuel gas (Combustion Engineering)	PDU	120 TPD	NA
Boiler fuel gas (Foster Wheeler)	Pilot	500 TPD	Unk
Flash pyrolysis (Garrett)	Bench	3 PPH	Some
	Pilot	250 TPD	NA
Molten salt (Kellogg)	Bench	Unk	Some
Multiple fluidized bed (BCRI)	PDU	100 PPH	None
Liquefaction			
CSF (Consol, Fluor)	Pilot	20 TPD	Some
	Bench	20 PPH	None
H-Coal (HRI)	PDU	200 PPH	None
SRC (Pittsburgh and Midway)	Pilot	50 TPD	None
Synthoil (Bureau of Mines)	Bench	50 PPH	Some
	PDU	10 TPD	NA

[a] Based on reference 33.

MM SCFD = million standard cubic feet per day
MW = megawatts
NA = not applicable
PDU = process development unit
PPH = pounds per hour
TPD = tons per day
Unk = information was not or could not be obtained during study

emissions significantly, but additional RD&D is required to improve the processes.[32]

The removal of sulfur oxides from stack gases after combustion has received extensive research and development attention over the last several years.[33] More than 50 "flue gas desulfurization" processes may be called technically feasible; that is, they have demonstrated the ability to remove sulfur dioxide (SO_2) from flue gas streams. The state of the art for these processes varies from bench scale through commercial scale demonstration. The methods fall into two basic types: those that transform SO_2 into a solid waste, and those that produce a salable sulfur product. Operation and maintenance problems are still being encountered with many systems currently in use.

Another approach to the problem is to remove the sulfur during combustion. In fluidized bed combustion, crushed coal is injected into the boiler near its base. It is then rapidly dispersed by air blown uniformly through a grid plate; thus, it becomes "fluidized". The means of removing sulfur dioxide is to inject limestone particles less than ⅛ inch in diameter, together with the crushed coal. The particles are noncombustible and act as acceptors of SO_2. All FBC systems also reduce nitrogen oxide emissions below the emissions standard for utility boilers—0.7 pound NO_2/million Btu.[34] Pressurized FBC systems can reduce NO_2 to 0.2 to 0.3 pound/million Btu.[34]

Processes to produce low-sulfur gaseous and liquid fuels from coal as an alternative to direct burning are under active research and development (see Table II-3).

The gasification process involves the reaction of coal with air, oxygen, steam, or a mixture of these, to yield a combustion product containing carbon monoxide, hydrogen, methane, nitrogen, and little or no sulfur.[35] The energy content of the product ranges from about 125 to 175 Btu per standard cubic foot (scf) for low-Btu gasification processes to about 900 to 1000 Btu/scf for high-Btu gasification processes. The latter is comparable to the energy content of natural gas.

A liquefaction process transforms coal into a liquid hydrocarbon fuel, simultaneously removing most of the ash and sulfur that pose environmental problems.[35] Reactions in liquefaction processes generally take place at lower temperatures and often at higher pressures than in gasification. Hydrogen is added in many of the direct and catalytic liquefaction schemes. Figure II-7 illustrates one of the basic methods for converting coal into oil or gas.

Coal System Comparisons

Understanding of the environmental implications of trends in the development and application of energy technologies begins with a look at entire energy systems, that is, the entire sequence of events from extraction of the resource, through conversion, to ultimate end use. A typical coal sequence is shown in Figure II-8. The examination of energy subsystems in this manner helps make explicit the en-

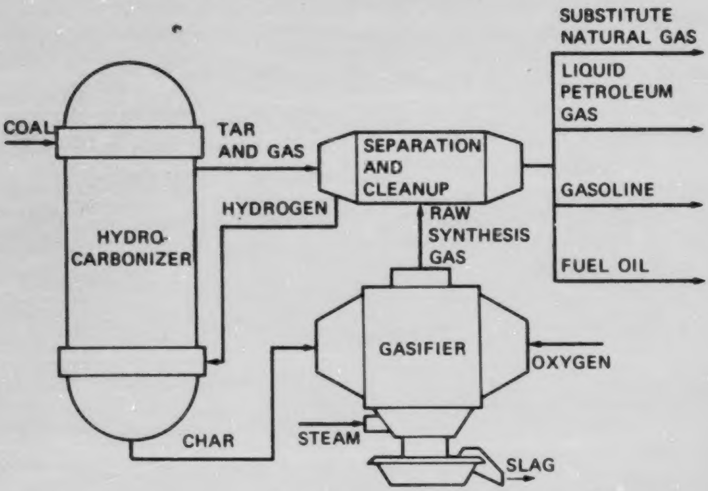


FIGURE II-7. The carbonization method converts coal into oil or gas by adding hydrogen to the coal. The process involves heating coal in the absence of air, causing the coal to decompose and to evolve tar and gas (Source: *Scientific American*, Vol. 234, 1976)[35]

vironmental implications of each step in the sequence and guards against overlooking any of them. Equally important, it permits comparisons of competing systems. By adding costs and efficiency to each sequential step, it is possible to make preliminary judgments about which technology may ultimately prove most acceptable to society, and to understand the factors influencing the trends with which we are concerned.

The assessment model in Figure II-9 shows the complexity of determining the ultimate environmental impacts of any step in a technology sequence. First, for each step, the "residuals" must be identified and counted or weighed. *Residuals* are the chemical substances emitted from an energy system, the air and water pollution, the solid waste generated, and the land disturbed. But characterizing residuals is only the beginning of the task of assessment. Means of controlling or mitigating the effects of the residuals must also be examined. Can the land be reclaimed, or the emissions kept from the water or atmosphere? The next step is to understand what happens to the substance after exposure to the environment. Is it transported great distances or transformed to a new state? Finally, the effects of residuals on human health and the ecosystem must be determined. In practice, environmental research does not follow a set of rigid steps. Research is conducted concurrently and interactively in all of these areas.

To measure environmental effects of coal technologies adequately, every link in the chain, from mining the resource to final end use of whatever product is produced, must be assessed. At present, attempts

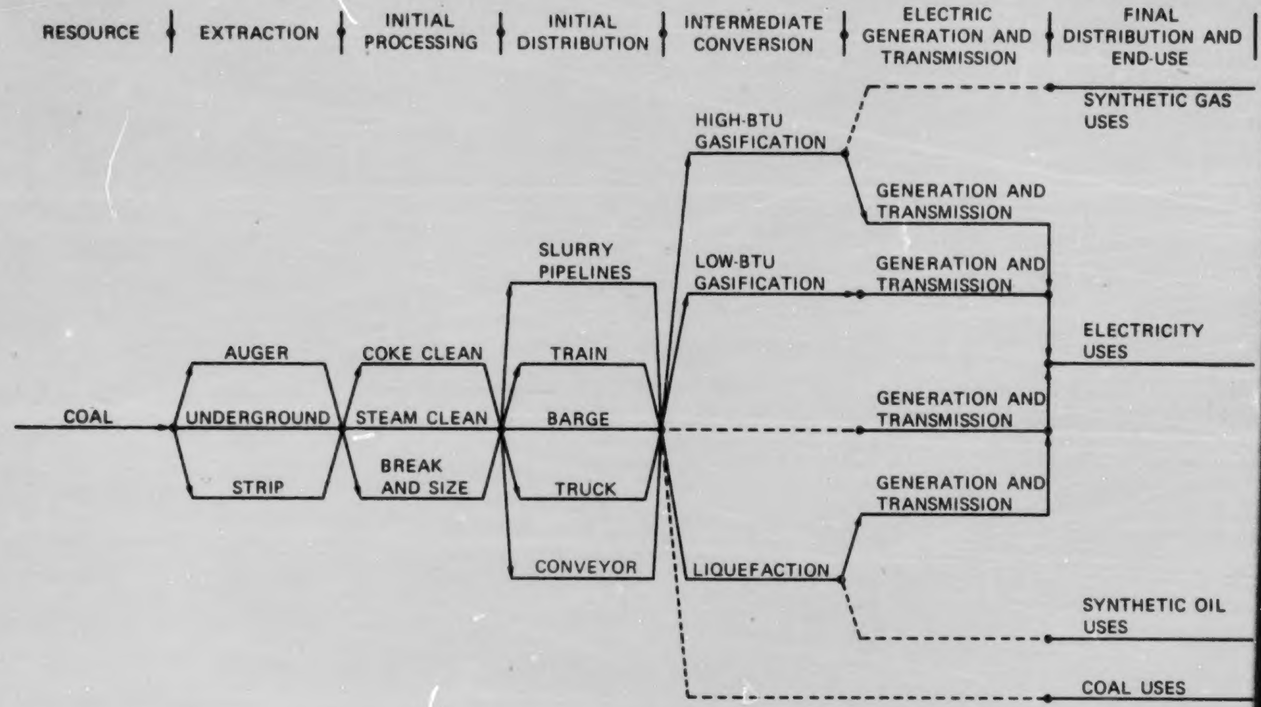

RESOURCE
EXTRACTION
INITIAL PROCESSING
INITIAL DISTRIBUTION
INTERMEDIATE CONVERSION
ELECTRIC GENERATION AND TRANSMISSION
FINAL DISTRIBUTION AND END-USE
COAL
AUGER
UNDERGROUND
STRIP
COKE CLEAN
STEAM CLEAN
BREAK AND SIZE
SLURRY PIPELINES
TRAIN
BARGE
TRUCK
CONVEYOR
HIGH-BTU GASIFICATION
LOW-BTU GASIFICATION
LIQUEFACTION
GENERATION AND TRANSMISSION
GENERATION AND TRANSMISSION
GENERATION AND TRANSMISSION
GENERATION AND TRANSMISSION
SYNTHETIC GAS USES
ELECTRICITY USES
SYNTHETIC OIL USES
COAL USES

FIGURE II-8. Example of energy supply system

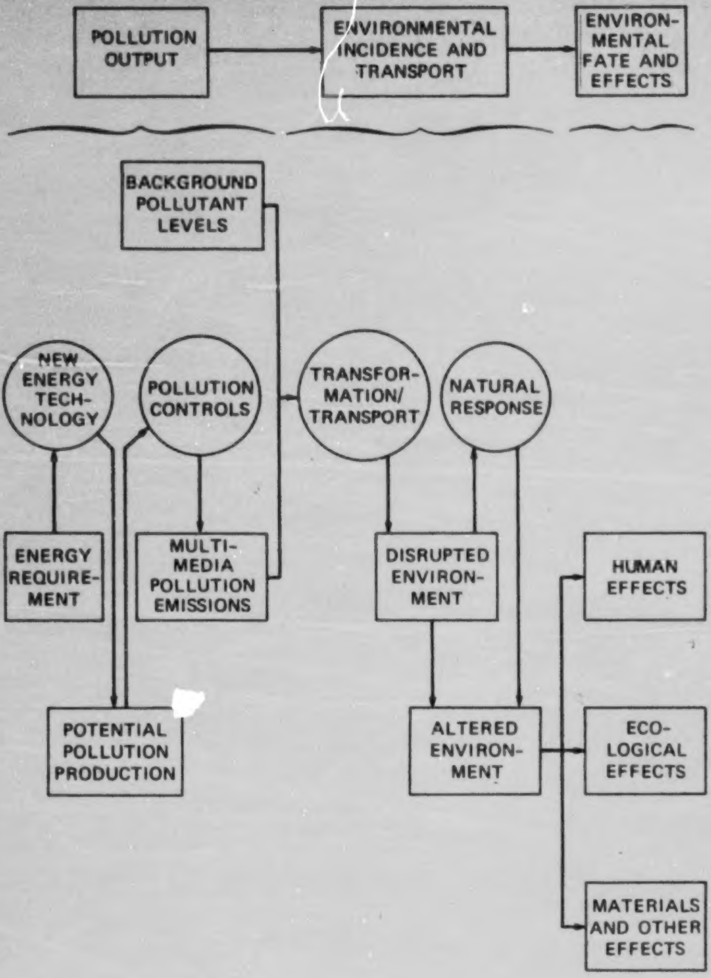

POLLUTION OUTPUT
ENVIRONMENTAL INCIDENCE AND TRANSPORT
ENVIRONMENTAL FATE AND EFFECTS
BACKGROUND POLLUTANT LEVELS
NEW ENERGY TECHNOLOGY
POLLUTION CONTROLS
TRANSFORMATION/ TRANSPORT
NATURAL RESPONSE
ENERGY REQUIREMENT
MULTI-MEDIA POLLUTION EMISSIONS
DISRUPTED ENVIRONMENT
HUMAN EFFECTS
POTENTIAL POLLUTION PRODUCTION
ALTERED ENVIRONMENT
ECOLOGICAL EFFECTS
MATERIALS AND OTHER EFFECTS

FIGURE II-9. Components of an environmental assessment (Source: Energy Resources Company)[35]

to compare environmental impacts of alternative technologies are generally focused on a comparison of residuals.[36] As we have seen, this is only a beginning. Production of residuals is a relatively early point in the process of measuring actual environmental effects. Notwithstanding the limitations, it is now at least possible and useful to estimate the residual production for some of the more common pollutants. For other pollutants, less common or less well understood, there are still major problems in ascertaining residuals.

Our 1975 Annual Report presented summary tables comparing the environmental residuals of several alternative fossil fuel technologies, carried as far as conversion of the fuel.[37] Overall energy efficiencies, water needs, and land requirements were also compared. Siting problems with mine-mouth conversion facilities were discussed. This year we look in more detail at atmospheric residuals for each step in four coal-based energy alternatives, and carry the analysis through to end use. We also examine the costs for each step.

Table II-4 illustrates the systems approach for some of the residuals of four alternative systems for using western coal to provide space heat for Chicago.[38] The coal is assumed to be surface-mined in eastern Montana near the Wyoming border and transported to Chicago via unit trains. There, it is either:

- Burned directly to produce electricity, which is then used to heat homes and buildings with electric resistance heating.
- Converted to a high-Btu gas, which is used directly to heat buildings.
- Converted to a high-Btu gas burned at a powerplant to produce electricity for resistance heating.
- Converted to a low-Btu gas to produce electricity for resistance heating of buildings.

Dozens of other possibilities could, of course, be considered.

Examination of the environmental data might suggest that among these alternatives, based on present understanding of the gaseous residual production from the systems, high-Btu gasification is environmentally most favorable, and direct electrification of coal the least favorable from the standpoint of air pollution. Of the alternatives considered, high-Btu gasification would appear to produce the least amount of air pollution per million Btu's of space heat. Such conclusions must be approached with great caution. The numbers listed in the table are of necessity based on many assumptions and very limited experimental data. The residual estimates for gasification are based primarily on expected experience at ancillary facilities, such as a powerplant providing electric power for the gasification facility. There is no U.S. experience at all with a full-scale, high-Btu gasification plant because none has been built. Clearly, these residuals are approximations at best and do not measure the actual environmental effects; until additional information is available, definitive assessments cannot be made.

Furthermore, we must consider the possible impacts of pollutants that are not included because we do not know enough about them. These pollutants may have more serious impacts than those we are presently able to estimate. Very limited pollutant measuring and monitoring have been performed on the small pilot plants that now exist (Table II-3). Major factors, such as water requirements, land use, and socioeconomic impacts, must also be considered.

Table II-4 presents another systematic comparison for the same energy sequences for energy resource efficiencies.[38] The estimated

TABLE II-4. Air pollution, efficiency, and cost estimates for alternative processes of converting western coal to residential space heat for Chicago[a, b]

Process steps	Particulates	SO_2	NO_x	CO	HC	Efficiency	Cost,[c] dollars/million Btu of space heat
	Pounds/million Btu of space heat						
Process: Urban electrification with scrubber (1)							
Mining	0.06	0.001	0.01	0.01	0.001		0.85
Transportation	0.004	0.07	0.05	0.003	0.001	1.0	2.20
Conversion							
Transportation							
Electrification	0.31	3.67	2.14	0.13	0.04	0.37	6.10
Scrubbing		−3.37				0.95	1.00
Distribution						0.93	2.90
End use						1.0	1.00
Total	0.37	0.37	2.2	0.14	0.04		14[d]
Overall efficiency						0.33	
Process: Urban high-Btu gasification (2)							
Mining	0.04	0.001	0.006	0.005	0.001		0.55
Transportation	0.003	0.046	0.03	0.002	0.001	1.0	1.40
Conversion	0.02	0.057	0.23	0.012	0.004	0.66	4.60
Transportation							
Electrification							
Scrubbing							
Distribution						1.0	1.10
End use	0.007	0.001	0.115	0.022	0.006	0.76	2.40
Total	0.07	0.10	0.38	0.04	0.01		10[d]
Overall efficiency						0.50	
Process: Urban high-Btu gasification/electrification (3)							
Mining	0.08	0.001	0.02	0.01	0.002		1.15
Transportation	0.005	0.09	0.06	0.004	0.001	1.0	2.90
Conversion	0.05	0.12	0.46	0.024	0.007	0.66	9.40
Transportation							
Electrification	0.27	0.002	0.54	0.053	0.003	0.40	3.90
Scrubbing							
Distribution						0.93	2.90
End use						1.0	1.00
Total	0.40	0.21	1.1	0.09	0.01		21[d]
Overall efficiency						0.25	
Process: Urban low-Btu gasification/electrification (4)							
Mining	0.06	0.001	0.01	0.008	0.001		0.90
Transportation	0.004	0.07	0.05	0.003	0.001	1.0	2.40
Conversion	0.0001	0.04	0.07	0.002	0.002	0.81	6.80
Transportation							
Electrification	0.27	0.265	0.54	0.05	0.003	0.40	3.90
Scrubbing							
Distribution						0.93	2.90
End use						1.0	1.00
Total	0.33	0.38	0.67	0.06	0.01		18[d]
Overall efficiency						0.30	

[a] Based on references 36 and 38.

[b] Data rounded for clarity.

[c] Cost (1975 dollars) and pollutant disaggregation somewhat arbitrary.

[d] Approximate.

energy efficiency is listed for each step in each sequence. Cumulative efficiency for the system as a whole is equal to the product of all the separate efficiencies in the sequence. It is a measure of the space heat energy divided by the input energy, defined as Btu content of the coal as it leaves the mine.[39] The energy required to build the capital equipment is not considered in this comparison; for purposes of this illustration, the coal transportation efficiency is assumed to be unity. It appears from the table that the cumulative efficiency for the high-Btu gasification sequence is substantially higher than the efficiencies of the alternatives considered. The reason is that the individual electrification and the gasification/electrification steps are inefficient in comparison with the high-Btu gasification step.

Interestingly, the economic comparisons suggest that the energy-efficient, high-Btu gasification may also be the least expensive (Table II-4). The high-Btu gasification/electrification sequence appears to be about twice as costly per Btu of useful space heat as the high-Btu gasification sequence. Systems involving "double conversion," that is, conversion of coal to a gas or liquid which is then converted to electricity, are more expensive and less efficient than single-conversion sequences, such as direct electrification or high-Btu gasification for direct burning in a furnace. Again, we must warn the reader that the data underlying this table are highly uncertain. The economics of high- and low-Btu gasification are not well established as no large-scale plants have been built and demonstrated.

It is worth remarking that the pollution generated by systems delivering space heat is very sensitive to efficiency at the point of end use, that is, the efficiency of furnaces or electric heaters. If, for example, a heat pump with an effective efficiency of 2.0 is substituted for the electric resistance heating of sequence (1), pollution at each step of the sequence is reduced, as shown in Table II-5. With increased efficiency of energy systems, the same human needs can be met with less environmental impact.

Comparisons such as these and others done for the Council suggest that electricity from coal and high-Btu gas from coal may be competing for use in commercial and residential buildings. A major factor in the outcome will be whether full-scale gasification technologies can operate economically.[40]

Process Characterization

Alternative coal technologies produce different mixes of air, water, and solid waste pollution and require different amounts of land resources. Identifying and quantifying these environmental residuals is known as "process characterization."

All of the alternative processes we have considered should produce less sulfur oxide pollution per Btu than direct burning of coal, even with flue gas scrubbing.[41] Combustion with scrubbers removes about 80 to 90 percent of the sulfur from the flue gas.[41] Experiments sug-

TABLE II-5. Air pollution estimates for converting western coal to residential space heat for Chicago [a] [b]

Process: Urban electrification with heat pump					
Process steps	Particulates	SO_2	NO_x	CO	HC
	Pounds/million in Btu of space heat				
Mining	0.03	0.0005	0.005	0.005	0.0005
Transportation	0.002	0.03	0.02	0.002	0.0005
Conversion					
Transportation					
Electrification	0.16	1.84	1.07	0.06	0.02
Scrubbing		−1.68			
Distribution					
End use					
Total	0.19	0.19	1.1	0.07	0.02

[a] Data rounded for clarity.
[b] Based on references 36 and 38.

gest that chemically active fluidized bed combustion can remove up to 98 or 99 percent of the sulfur.[41] Low-Btu gasification generally removes over 90 percent of the sulfur from the product gas and consequently from the combustion products.[41] High-Btu gasification produces gas that is essentially sulfur-free, containing only a few parts per million.[41] Most sulfur should be removed in liquefaction processes as well.[41]

Compared with conventional combustion, gasification should also lead to lower levels of nitrogen oxide formation, provided that careful control is maintained at the end-use point.[42] As already noted, fluidized bed combustion can also reduce nitrogen oxide formation.[42] For liquid fuel products, the case is not as clear. Characterization of the liquid fuel products and experiments on nitrogen oxide formation are both needed to evaluate liquefaction relative to conventional combustion.[42]

It is very difficult to make similar comparisons of other pollutants that might be emitted from different coal technologies. The first step, as illustrated in Figure II-9, is to characterize products found in the gaseous or liquid fuel produced, in the liquid and solid wastes coming out of the plant, and in emissions to the atmosphere. Table II-6 lists the range of potentially harmful substances that *could be* associated with coal technologies. As can be seen, potentially harmful health effects range from minor eye, nose, throat, and skin irritation to serious or possibly fatal disease. Obviously, it is essential to learn whether these materials will in fact be present in significant quantities in the new technologies.

Process characterization for gasification and liquefaction technologies is still in its early stages. Very little characterization has taken place in the laboratory or in pilot plants.[43] Much more work can and should be performed at these stages, even though the data may differ

TABLE II–6. Some potentially hazardous substances that could be associated with coal conversion technologies[a] [b]

<table>
<tr><th colspan="2">More poorly understood</th></tr>
<tr><th>Higher significance</th><th>Lower significance</th></tr>
<tr><td>Benzene: Suspected to cause leukemia
Beryllium: Suspected to cause bone and lung cancer
Cadmium: Possible relation to prostate cancer
Fluorides: May increase sensitivity to chemicals affecting central nervous system
Lead: Suspected occupational carcinogen
Nickel: Occupational cancer incidence
Nickel carbonyl: Causes lung cancer, possibly asthma
Nitric acid: Can irritate eyes, lungs, mucous membranes, skin and corrode teeth
Nitric oxide: Can cause pneumonia, circulatory system damage; suspected respiratory irritation and tooth corrosion
Nitrogen dioxide: Suspected to reduce resistance to bacteria; acute exposure causes increased respiratory inhibition
Phenols and cresols: Occupational carcinogen (skin); may damage central nervous system and liver
Selenium: Occupational cause of digestive and nervous disorders
Sulfur dioxide: Correlates with chronic respiratory diseases; synergistic effects with particulates
Zinc chloride: Possible carcinogen</td><td>Carbon monoxide: Suspected to alter enzyme activity; cause behavioral changes; and precipitate heart attacks
Fluoride: Suspected association with blood disorders
Manganese: Causes brain damage and pneumonia in high doses
Xylene: Inhibition of electrical activity in cerebral cortex at levels below odor threshold
Vanadium: Acute respiratory irritation; chronic ingestion produces systemic symptoms
Zinc oxide: Occupational exposure can cause intestinal, respiratory, skin and nervous disorders</td></tr>
<tr><th colspan="2">Better understood</th></tr>
<tr><td>Beryllium: Causes acute and chronic respiratory disorder from short-term exposure
Chromium: Suspected cause of lung cancer
Fluorides: High levels lead to chronic poisoning or fatality; can cause respiratory impairment
Lead: Damages central nervous system
Mercury: Damages central nervous system
Polycyclic aromatic hydrocarbons: Carcinogenic
Uranium: Insoluble compounds damage lungs; salts damage kidneys and arteries</td><td>Arsenic: Lethal at high doses
Barium: Eye, nose, throat, skin irritant; salts and sulfide poisonous
Beryllium: Causes chronic berylliosis
Cadmium: Systemic and fatal effects from inhalation of high concentrations
Carbon monoxide: Causes dizziness, fatigue, and coronary dysfunction
Chromium: Occupational exposure causes lesions of skin and mucous membranes
Cyanides: High concentrations lethal
Phenols and cresols: Corrodes skin and mucous membranes
Selenium: Causes dermatitis and respiratory irritation
Toluene: Chronic exposure can cause brain damage</td></tr>
</table>

[a] Based on reference 33.

[b] The basis for the ranking of a substance is a combination of the substance's inherent toxicity and the degree of human exposure anticipated. The latter is a relative measure, reflecting the increase in concentrations over urban or rural background levels, the concentration expected as compared with the level thought to be harmful, and the number of persons who will be affected.

Each effect is placed in the grid according to its ranking of significance and how well it is understood. The list of problems is not comprehensive and does not incorporate all advances to date in the assessment of current knowledge. However, the most important effects are believed to be covered. Some substances are listed more than once depending on the effect and the level of understanding.

from results in demonstration and commercial-sized units. The process conditions will not be identical, although they can be approximated; and small-scale systems typically do not contain all of the processing steps of a full-scale unit.

The wide difference in health effects from two similar compounds, both of which may be produced by coal gasification technologies, shows the need for careful characterization of the chemical form of the residuals. Processes that use a nickel catalyst in the gasifier may introduce trace amounts of nickel, which then forms nickel compounds that could be present in the gas delivered through the pipeline. One such compound, nickel subsulfide (Ni_3S_2) has been found to be quite carcinogenic; another, nickel sulfide (NiS), is apparently not carcinogenic.[44] Present characterization data are not adequate to determine the presence or absence of significant trace amounts of nickel in the gas. Equally important, most analyses of inorganic trace metals do no more than distinguish the elements present and do not characterize the molecular structure of the compounds.[45] They would not distinguish between the two nickel compounds.

All of these considerations point to a need for priority emphasis on process characterization for new technologies. Until more experimental data are available, it is not possible to conclude that fuels produced from coal gasification and liquefaction will be environmentally superior to the more conventional alternatives.

Health Effects

The analysis of health effects is one of the vital steps in the assessment chain. We have limited knowledge about the health effects of chemicals that may be part of the residuals, and such information is very difficult to obtain. Information is needed on the toxicologic, carcinogenic, mutagenic, and teratogenic activity of these compounds.

Human experience provides the best basis for estimating health risks quantitatively. The most valuable studies generally involve exposed workers. This is because the workplace is usually that part of the human environment in which chemical exposures are most severe and because findings from such studies often give the first indication of more general environmental problems.

In studies where exposures can be defined and the effects are immediate, it is possible to estimate relationships between dose and effect. Chronic effects, either delayed or showing up only after long-term exposures, are often very difficult to detect, however, even if the effect is severe. One reason is that Americans are extremely mobile, changing jobs and homes and moving around the country. It is often difficult to isolate or even remember exposure experiences that occurred many years or decades earlier. Other reasons that make the measurement of long-term chronic effects difficult include exposures from a wide variety of low-level sources, different susceptibilities of exposed groups, similar responses to other pollutants, and individual differences of habits and life history.

Studies on humans are in general expensive and lengthy, and involve following large numbers of people who have been exposed to the study chemical. For new chemicals where there is no current human experience, however, such studies cannot be used to evaluate health effects without resorting to human experimentation. Thus, epidemiological studies of human experience have limited use. Even at best, detailed information of this type will not be generally available in the next 10 to 15 years when some decisions on coal conversion technologies will likely be made.

For the most part, toxicological studies conducted in the laboratory must substitute for human studies in evaluating health effects. Traditionally, these studies expose animals to known levels of the chemical under investigation and note their effects. Because of relatively short lifespans, rapid metabolism, and differences in metabolic pathways, physiology and anatomy, adverse health effects appear sooner. But even with rodents, the most convenient test animals, such experiments may take 2 to 3 or more years, and costs may run into four or five figures. Time, costs, and limited available toxicological resources mean that only a portion of the residuals can be investigated by means of animal studies. Moreover, our limited understanding of the exact relationship between human and test animal metabolism means that the results of such studies may be more qualitative than quantitative.

Promising new toxicological screening methods are under development that would cost a few thousand dollars per substance or perhaps less, and would take a few days or weeks, rather than years.[46] With these techniques the chemical's effect is tested on cells grown in test tubes or Petri dishes. When developed, these techniques too will yield qualitative, but probably less quantitative, results. There is a need to validate the test system data in higher organisms and humans to provide more quantitative estimates of human hazards.

Residuals from coal processing and use are complex mixtures of inorganic and organic substances, whose effects may be interdependent in a synergistic way. These synergisms further complicate health effects assessments. Different coal processes result in different mixes of residual chemicals, each mixture containing many complex chemical compounds. A more systematic approach is needed for characterizing the many known and suspected carcinogens or cocarcinogens in the numerous process/emission streams of a coal conversion plant. Even with the most rapid and inexpensive technological procedure, the fundamental decision remains—whether to test each possible different effluent stream, or to test the chemical components that may be common to several residual streams.

Several important research goals must be met to improve our ability to assess health risks from coal technologies, in addition to improving and interacting with more fundamental research data bases. First, rapid, inexpensive toxicological screening methods need additional development. Second, we need a better understanding of the precise relationship between laboratory animal metabolism or cell cultures and human experience to allow quantitative estimates of health risks. Third, for better epidemiological studies, we need the improved capability to isolate and identify past and present exposures to chemicals. Unless these needs are met, research on health effects probably cannot match the pace of developing coal technologies.

FINDINGS

This discussion emphasizes the complexities of analyzing environmental consequences in the development and application of energy technologies. At this point, it is not possible to say with any degree of certainty whether overall environmental impacts will increase or decrease in severity with time. Serious impacts are a possibility that must be constantly addressed. Keeping in mind the gaps in our understanding, the Council has found that:

- Total energy demand will be a major factor influencing environmental consequences of energy systems in the future. Although estimates of demand for the year 2000 vary widely (100 to 190 qBtu), growth is not likely to continue over the longer term at the high rates of the past. The level of energy demand in the year 2000 could be toward the lower end of this range.
- If efforts to slow the growth in energy demand and substitute alternative technologies that have less adverse environmental impacts are not effective, the levels of many pollutants could increase sharply in the next 25 to 50 years.
- Development and application of conservation technologies are among the most important means of achieving environmental quality and providing time to understand better the impacts of alternative energy strategies.
- Another major determinant of environmental consequences will be the mix of energy sources. The proportion of coal, an environmentally difficult fossil fuel, in this mix is likely to increase substantially for the rest of the century. Coal production may be two to three times current levels by the year 2000.
- Major increases in electricity production from direct burning of coal could have significant adverse air quality consequences, in the absence of improved combustion and pollution control technologies.
- Gasification and liquefaction of coal may offer major air quality advantages for currently regulated pollutants, but they present uncertain, potentially serious hazards for pollutants that are not yet regulated.
- To understand better the implications of much expanded use of coal, high priority should be assigned to characterization of pollutants from coal conversion technologies and to biological

and toxicological screening. Effluents and products from existing facilities, including pilot plants and demonstration plants, should be analyzed intensively, and their effects studied.

AIR QUALITY

Although not all of the specific requirements of the Clean Air Act are being achieved in all regions of the country, the nation is making significant progress in improving its air quality. This section focuses primarily on the attainment of the primary air quality standards (those established to protect human health) in the larger Standard Metropolitan Statistical Areas having the greatest difficulty in achieving the air quality goals. We use a new environmental data analysis and display capability developed by CEQ which provides greater insight regarding current and future air quality problems across the nation and a more complete picture of the health risks of each pollutant on a region-by-region basis.

Our analysis suggests that, for several major pollutants, most of the nation's 247 Air Quality Control Regions (AQCRs) have met or can meet the primary health-related air quality standards by the early 1980's. Primary standards have been set for five "criteria" pollutants: sulfur oxides, total suspended particulates, carbon monoxide, photochemical oxidants, and nitrogen dioxide. For at least three of these pollutants, the outlook is good for achieving the standards in the not too distant future. Attainment of the sulfur dioxide standard is already widespread; progress in reducing particulate levels is significant; and carbon monoxide levels are improving enough to suggest that all but a few regions will meet the standards in the next few years. Some uncertainties limit the accuracies of projections for oxidants and nitrogen dioxide. Nonetheless, on the basis of present data, it seems likely that risks from nitrogen dioxide can be minimized, and that major improvements in oxidant levels will be achieved, if strict attention is paid to enforcement of existing (automobile) standards and if stationary source emissions are controlled.

Even for the most troublesome areas, the question is not so much if they will attain standards, but when. Realizing the full benefit of reductions in automobile emissions, for instance, requires that all pre-1975 cars be replaced by newer models that meet the statutory standards. This process inevitably takes time. Stationary sources have also experienced great difficulty in installing the necessary technology in a very brief time.

However, some areas have uniquely difficult problems—the severe ozone problem in Los Angeles and carbon monoxide problem in New York City being preeminent examples. Such areas may require exceptional control strategies to attain the national standards.

The focus here on achieving primary standards in the most troublesome areas does not imply that they are our only air quality problems. There are many others among them—the attainment of secondary standards, the effects of pollutants for which standards have yet to be set; nondeterioration of air quality in unspoiled areas; rural agricultural damage caused by pollution from urban centers; and global air pollution.

Non-health-related effects of air pollution—crop losses, destruction of ornamental plants, soiling, and reduced visibility—are covered by secondary standards. These standards are equal to or more stringent than current primary standards, but recent research suggests that effects may occur at concentrations even below some present secondary standards.

Several pollutants other than the "criteria" pollutants discussed will be controlled under the provisions of the Clean Air Act. These pollutants include asbestos, beryllium, mercury, sulfuric acid mist, fluorides, vinyl chloride, and lead. For the most part, measurements for these pollutants are made at fewer stations and less frequently than for the five criteria pollutants, so that comparable status and trends analysis is not possible. Impacts for most of these pollutants occur on a limited local scale around the specific industries that emit them. Lead emissions from the ubiquitous automobile are the exception. The status of control programs for these pollutants is covered in EPA's Annual Report to Congress.[47] The future of lead emissions control is discussed in Chapter I of this Annual Report.

For all pollutants, there is a need to develop more accurate descriptions of the human health risks and more sophisticated indicators that include such factors as how many persons are exposed, how individuals differ in their sensitivity, and how pollution levels vary within a region. A short-time daily indicator incorporating some of these factors has been developed which can be used for nationwide comparisons of air quality.

"CRITERIA" POLLUTANTS

Progress in cleaning up the nation's air can be evaluated in several ways. In past reports, we have presented data on the number of regions in compliance with EPA's air quality standards as a gauge of progress toward achieving the mandates of the Clean Air Act.

Under the provisions of the Clean Air Act, EPA has established standards for sulfur oxides, total suspended particulates, carbon monoxide, photochemical oxidants, and nitrogen dioxide. (Table II-7 is a list of these standards.) Besides limiting the concentration, the short-term standards also specify a limit on the number of violations per year. The frequency of violations is highly dependent upon meteorological factors as well as upon pollutant emissions.

Let us consider an analogy. Long, unusual periods of heavy rainfall can cause flooding of streams and rivers, with severe flooding occurring only once in 25 years. Such a flood, however, does not reflect the year-to-year average stream flow. Similarly, air pollution

TABLE II-7. National ambient air quality standards[a]

Pollutant	Averaging time	Primary standards	Secondary standards
Particulate matter	Annual (geometric mean)	75 µg/m^3	60 µg/m^3
	24 hour[b]	260 µg/m^3	150 µg/m^3
Sulfur oxides	Annual (arithmetic mean)	80 µg/m^3 (0.03 ppm)	—
	24 hour[b]	365 µg/m^3 (0.14 ppm)	—
	3 hour[b]	—	1300 µg/m^3 (0.5 ppm)
Carbon monoxide	8 hour[b]	10 mg/m^3 (9 ppm)	10 mg/m^3 (9 ppm)
	1 hour[b]	40 mg/m^3 (35 ppm)	40 mg/m^3 (35 ppm)
Nitrogen dioxide	Annual (arithmetic mean)	100 µg/m^3 (0.05 ppm)	100 µg/m^3 (0.05 ppm)
Photochemical oxidants	1 hour[b]	160 µg/m^3 (0.08 ppm)	160 µg/m^3 (0.08 ppm)
Hydrocarbons (nonmethane)	3 hour (6 to 9 a.m.)	160 µg/m^3 (0.24 ppm)	160 µg/m^3 (0.24 ppm)

[a] The air quality standards and a description of the reference methods were published on April 30, 1971, in 42 C.F.R. 410, recodified to 40 C.F.R. 50 on July 1, 1975.

[b] Not to be exceeded more than once per year.

levels vary with the weather on a daily basis. An abnormally long period of sunny, calm weather causes exceptionally high levels of pollution where automobile emissions are high. Extreme levels vary from year to year with no changes in emissions because of differences in annual weather extremes. The expected year-to-year extreme must be determined by statistical analyses of several years of data.

The design of regulatory programs at all government levels must take into account these natural year-to-year fluctuations in the extreme pollution levels. The current federal short-term standards, which vary from hourly to 24-hour limits, specify that they should not be violated more than once per year.

Previous Annual Reports have limited the analysis to a simple count of regions in compliance with, or in violation of, the standards. Although such analysis does indicate the legal situation of compliance or noncompliance, it gives little idea of the relative public risk among regions, or the degree of risk in each one. The air quality data analysis used in this year's Annual Report examines measured concentrations of pollutants and their frequency of occurrence to give a two-dimensional look at air quality.

We have examined air quality data for the five criteria pollutants from 26 representative regions, selected from the 247 AQCRs that cover the nation's total population. The regions chosen for analysis were, for the most part, the major urban centers with the most severe air pollution problems.

We assume that air pollution is greatest in cities with the highest populations. Improvement in such cities should signify improvement in smaller towns and rural areas. All urban areas have been subject to the same control strategies, whether they are nationally imposed automobile and stationary source emissions standards or locally imposed regulations. Exceptions are usually due to special local problems that can be solved only on a local case-by-case basis.

Most of the air quality data considered in the following subsections were extracted from EPA's air quality data bank, although some were obtained directly from local pollution control agencies and other sources. The data are derived from selected monitoring sites, chosen as most representative of the urban regions under study. Many local agencies were consulted to ensure that the data selected were representative. We have supplemented the CEQ analysis with reports from EPA and other agencies, where appropriate. All emissions trends analyses are from EPA sources.

Sulfur Dioxide and Total Suspended Particulates

The primary air quality standards for sulfur dioxide (SO_2) and total suspended particulates (TSPs) were derived from population studies involving both pollutants. Therefore, SO_2 and TSP air quality data should be examined together.[48] More recent evaluations confirm that the two pollutants in association are related to health effects. However, their presence may only indicate the existence of other pollutants such as sulfates. Evidence now shows that these

Pollutants released by a steel corporation's coke plant fill the valley around Clairton, Pennsylvania. Such single-industry pollution problems are typically unique to small towns. Establishment of national emissions standards for specific industries helps to alleviate air pollution in large metropolitan regions and eliminate these single-industry problems (Photo credit: U.S. Environmental Protection Agency—Documerica, John L. Alexandrowicz)

compounds may be primarily responsible for the health effects originally attributed to SO_2 and TSP.[49]

Atmospheric sulfates, especially sulfuric acid aerosol, are derived from SO_2 emissions, being formed through several chemical reactions in the atmosphere. When measured from the atmosphere at monitoring stations, the sulfates appear as a fraction of TSPs.

The presence of both SO_2 and TSPs is probably a good indicator of the presence of sulfates, although the converse is not necessarily true. It is possible to have high sulfate levels and low SO_2 or TSPs because sulfates may be windborne from considerable distances. Sulfur dioxide emissions from rural sources, such as ore smelters or powerplants, may be converted to sulfate and transported to areas where SO_2 emissions and atmospheric levels are low.

Development of a separate regulatory program for sulfates is an ultimate goal,[50] but much of the information necessary to establish standards and control programs for sulfates is lacking. A major research effort is required to study the movement of sulfates to the environment from their sources, the chemical composition of sulfur compounds, and specific health effects of these pollutants. While research proceeds, regulatory programs to control SO_2 emissions appear to be the only definitive means of reducing potentially hazardous sulfate aerosol levels in the air.

Although TSP levels are still above the mandated standards in many parts of the country, their associated SO_2 levels are well below the standards in all but a few regions. Figure II-10 displays the analysis for particulates in the AQCRs selected as a cross section of the nation's urbanized areas. These diagrams, showing the impact in terms of measured particulate concentrations and the number of days that these concentrations were observed, can be compared readily with the primary and secondary standards. The number of days during which the primary standards were violated during the year are shown for each of the two monitoring sites within each region.

Figure II-10 clearly demonstrates the advantage gained from considering air pollution problems in two dimensions rather than one. If a region is categorized simply by one or more violations of the standard, then no distinction is made between St. Louis, for example, and Cleveland. The diagrams here show that Cleveland is in violation of the standards many more days than St. Louis, and atmospheric levels of TSP are higher. The shaded area represents degree and duration of pollution above the primary standard; the clear area relates to the secondary, or welfare standard.

In addition to the standard that sets a daily maximum for TSP levels, EPA has also established an annual average standard to protect against chronic impacts on health. Figure II-11 presents the results of an EPA study,[47] showing the number of regions where at least one monitoring site recorded TSP levels in violation of the annual standard. The TSP level reported is the highest value recorded by any monitoring site in the region.

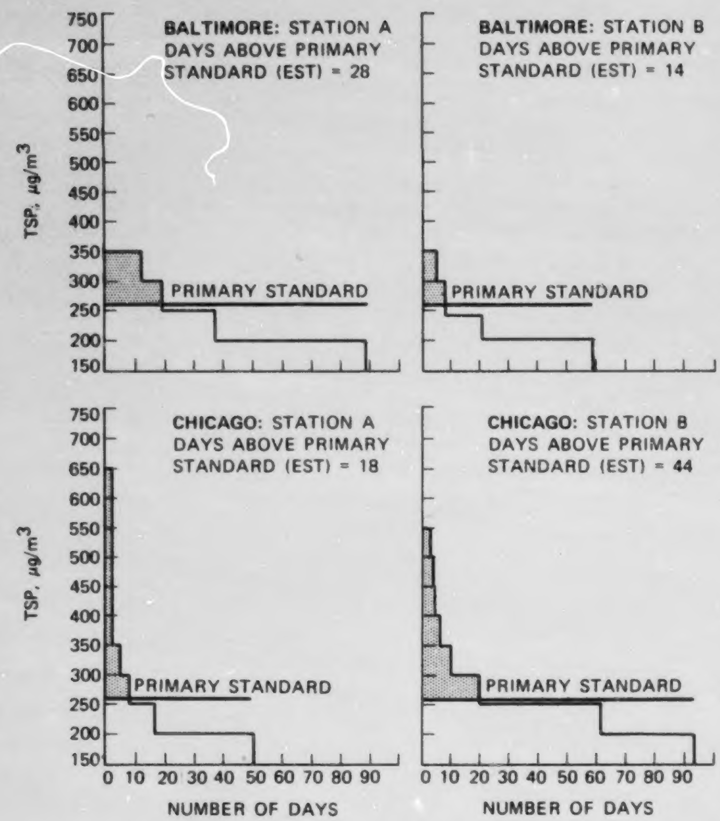


FIGURE II-10. Distributions of 24-hour particulate levels for eight cities (1974 data)

We have expanded the analysis to include population exposure, estimating the numbers of persons exposed at each monitoring site, and have also included TSP readings at all monitoring sites within the region, rather than just the station with the highest readings. Figure II-12 gives the results, showing the population exposed to various TSP levels above the standard. The EPA study found that 65 percent of all reporting regions (111 out of 198) showed at least one station above the annual standard. The addition of population figures plus *all* TSP monitoring data provides greater insight into actual levels of risk within each region. The entire area of the bars in Figure II-12 represents the distribution of the population exposed to TSP levels above the standard in the 111 regions, based on the single high station. One might erroneously conclude that 129 million persons in the affected regions would seem to be at risk. The addition of all monitoring data lowers the exposure figure to 68 million persons

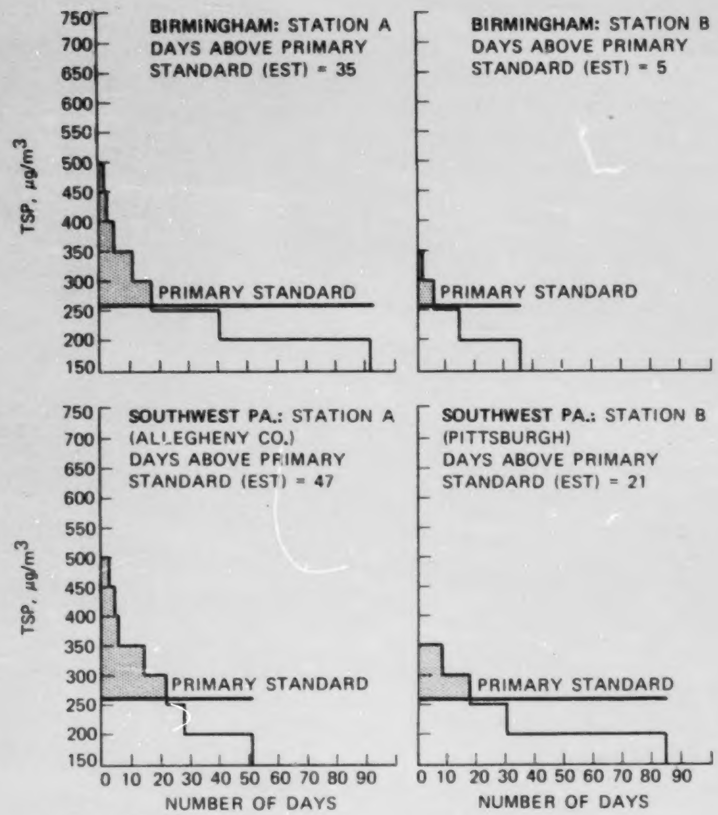


FIGURE II-10—Continued

within the regions in violation of the TSP standard, as represented by the shaded area of the bars. Further, the degree of risk, that is, the number of persons exposed to various levels above the standard, seems to be much lower when both factors, population and concentration, are viewed simultaneously.

Among the regions cited in Figure II-11 as violating the annual TSP standard, are 67 where most of the particulates measured are fugitive dust. Windborne dust from desert storms, from agricultural operations, and from heavy use of unpaved roads creates such problems. Excesses of windborne dust have more effect on welfare than on health because sulfur compounds (or other specific health related pollutants) are generally not present.

Figure II-13 shows the distribution of daily SO_2 levels for four regions. These regions were the only ones among the 26 studied by CEQ with significant measurements above the primary daily standard, and the figures demonstrate that the violations in three of the

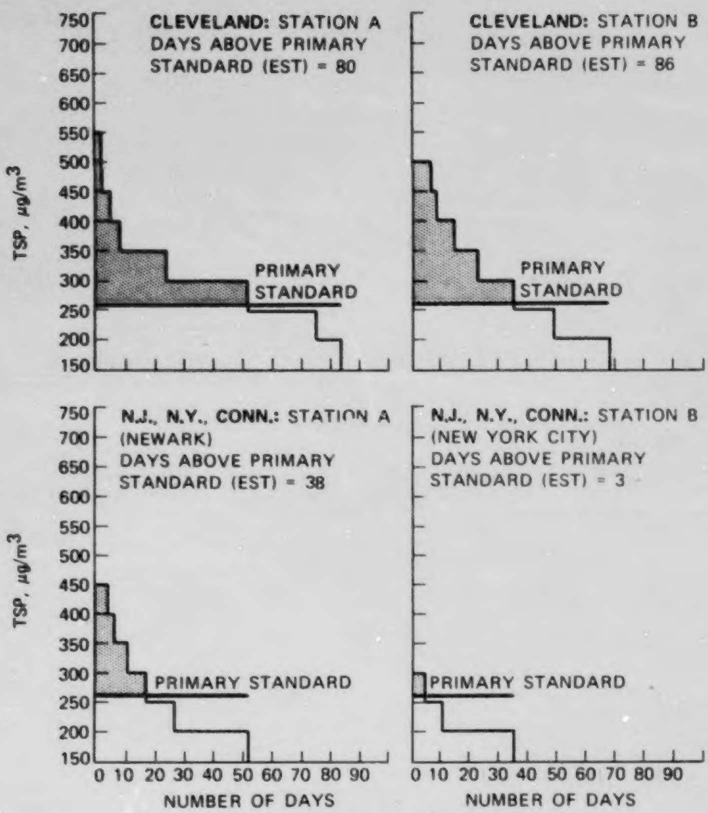


FIGURE II-10—Continued

regions were quite minor. The comparatively high levels in St. Louis arise from a cluster of industry in South St. Louis, which still emits large quantities of SO_2.

A review of all available sulfur dioxide data indicates that the SO_2 levels are generally low in the larger metropolitan areas. However, we have less information on rural SO_2 pollution, which can be caused by large stationary sources such as coal-fired powerplants and smelters. These sources are important because their emissions may contribute to sulfate levels found in urban areas.

EPA has set annual standards for SO_2 as well as for TSP. Figure II-14 gives EPA data on regions exceeding the standard in a fashion similar to that for TSPs (see Figure II-10). Few regions violate the standards, and the number and extent of excesses above the standards are generally low. Almost all of the violations involve large point sources. Population exposure analysis was also performed on these

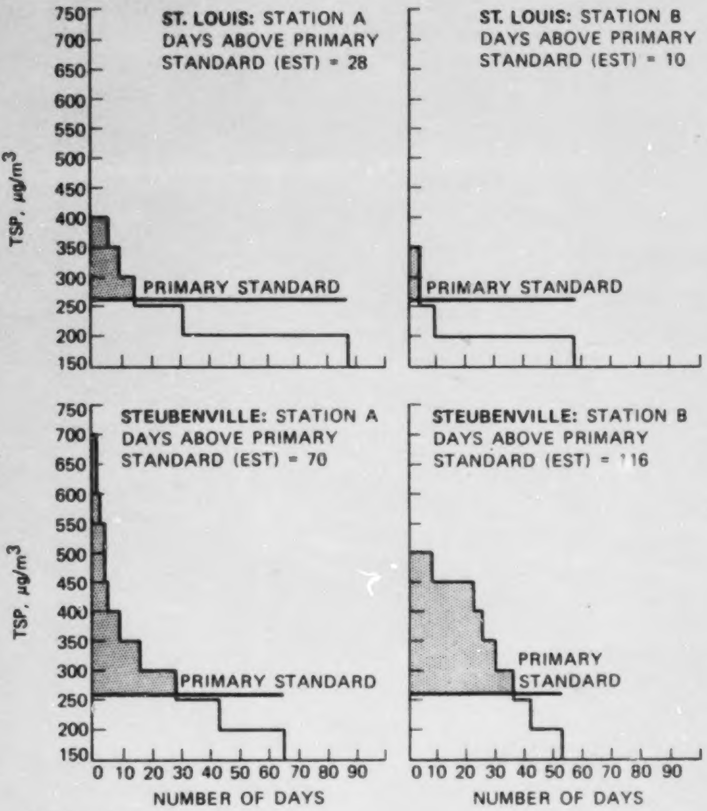


FIGURE II-10—Continued

data, and the results are shown in Figure II-15. In the handful of regions violating the standard, it appears that about 13 million persons are at risk in the 11 regions, if data from all monitoring sites are included. There are few regions violating both the TSP and SO_2 standards.

SO_2 and TSP levels have shown marked decreases over the past 5 years in almost all regions analyzed, giving evidence of the effectiveness of national and local regulatory programs. Figure II-16 summarizes daily TSP observations for the years 1970-1975, revealing trends in TSP air quality levels. All cities except St. Louis show a clear and significant improvement. Figure II-17 shows the SO_2 trend history for New York City. Where the downward trends in TSP are temporarily reversed, the reason is attributable to differences in weather from one year to the next. An exceptionally cold winter increases TSP and SO_2 levels, as more fuel is burned, while a very mild winter does the reverse. EPA's trend analysis on TSP and SO_2 is shown in Figures II-18 and II-19.[51] Figure II-19 adds population exposure for average exposure levels.

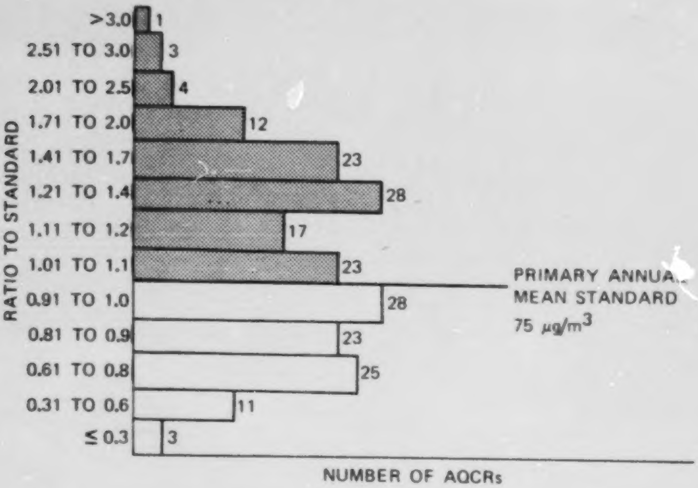


FIGURE II-11. Distribution of Air Quality Control Regions based on maximum single station observation for particulate levels (no data available for 49 regions) (Source: U.S. Environmental Protection Agency)[47]

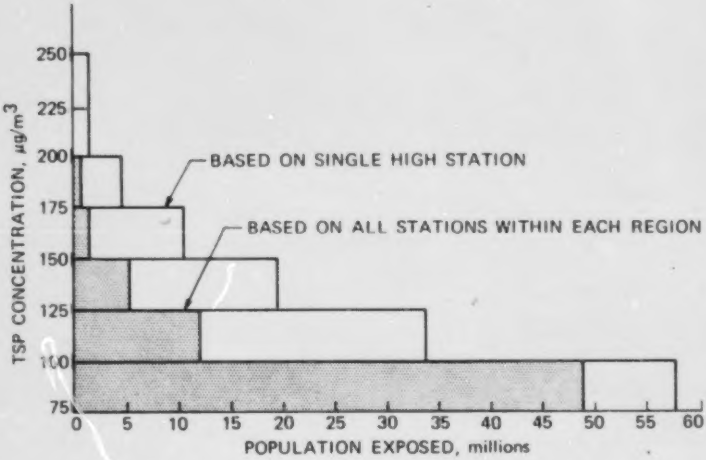


FIGURE II-12. Population exposure distributions of the 111 Air Quality Control Regions whose annual particulate levels exceed the national air quality standard

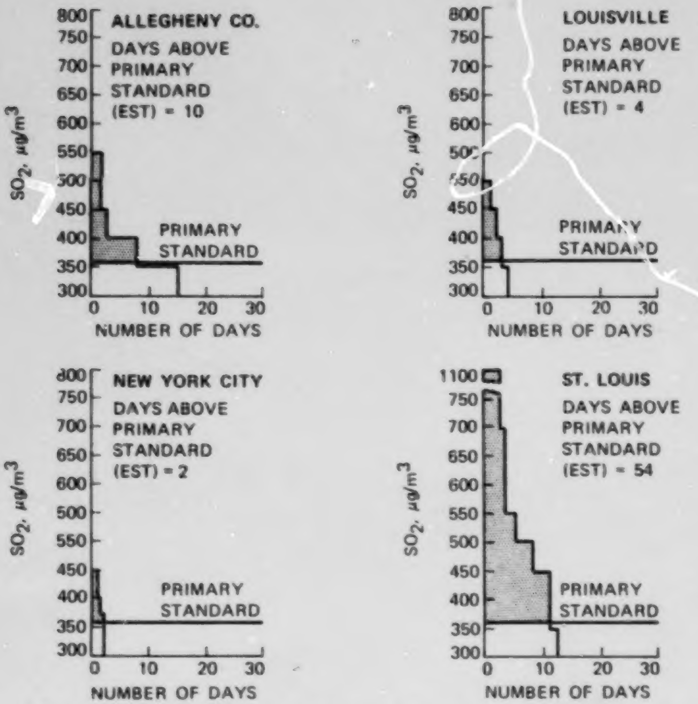


FIGURE II-13. Distributions of 24-hour sulfur dioxide levels for four cities (1974 data)

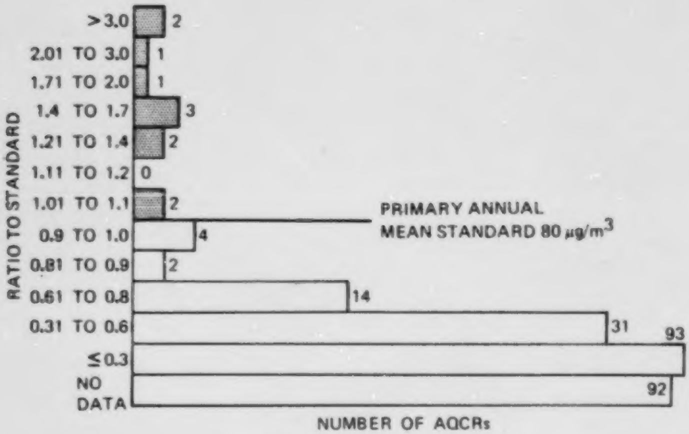


FIGURE II-14. Distributions of Air Quality Control Regions based on maximum single station observation for annual mean sulfur dioxide levels (no data available for 92 regions) (Source: U.S. Environmental Protection Agency)

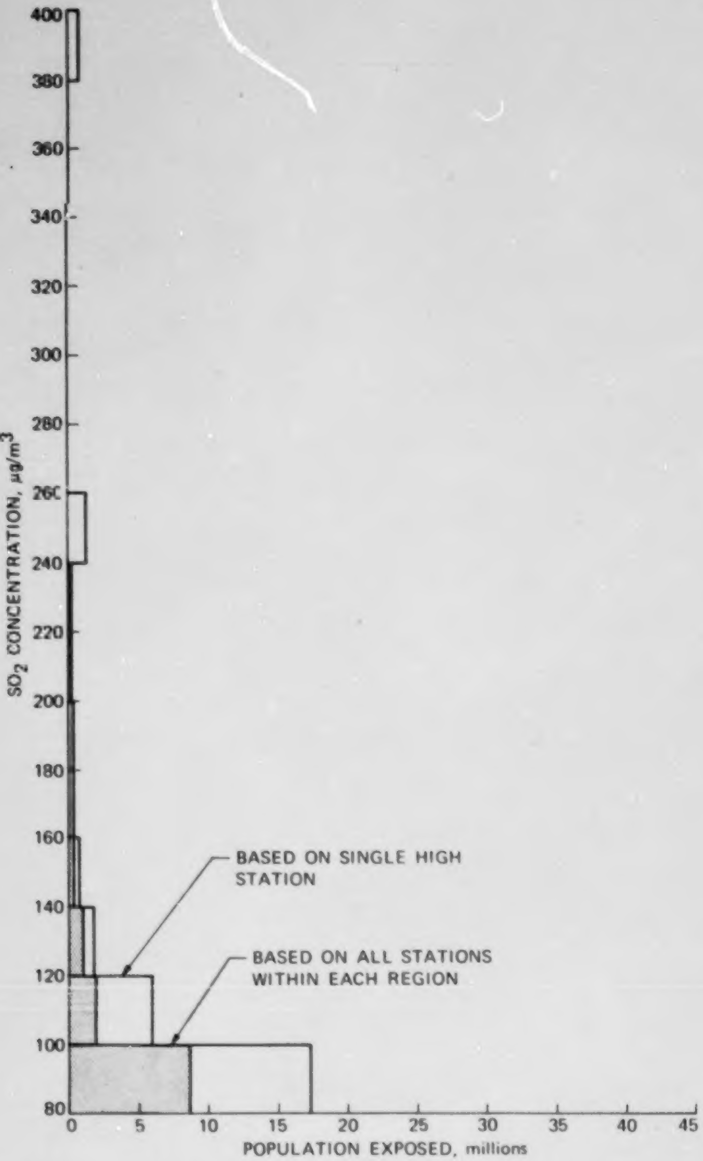


FIGURE II-15. Population exposure distributions of the 11 Air Quality Control Regions whose annual sulfur dioxide levels exceed the national air quality standard

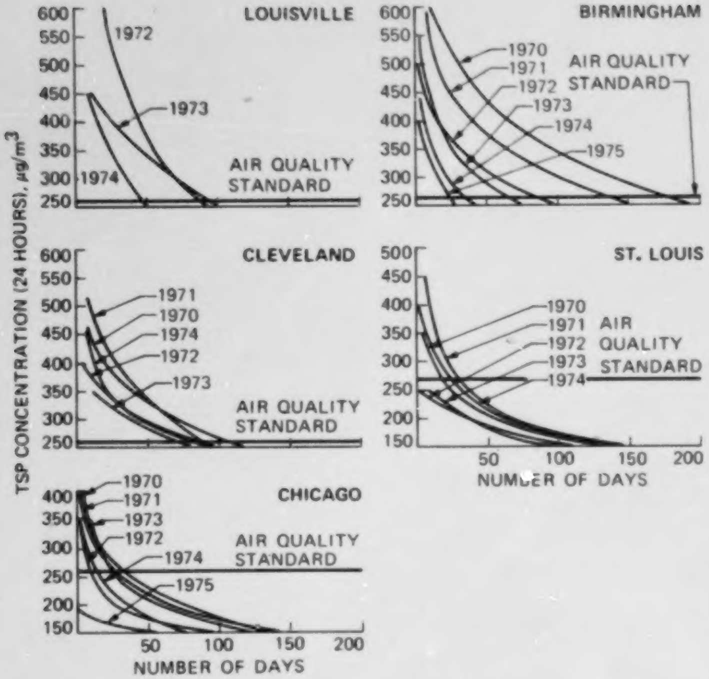


FIGURE II-16. Trends in levels of total suspended particulates for five cities

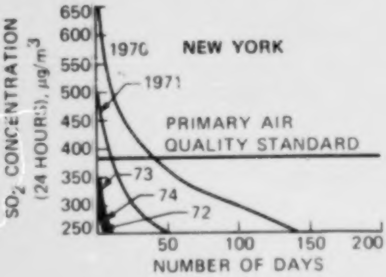


FIGURE II-17. Trends in 24-hour levels of sulfur dioxide for New York City

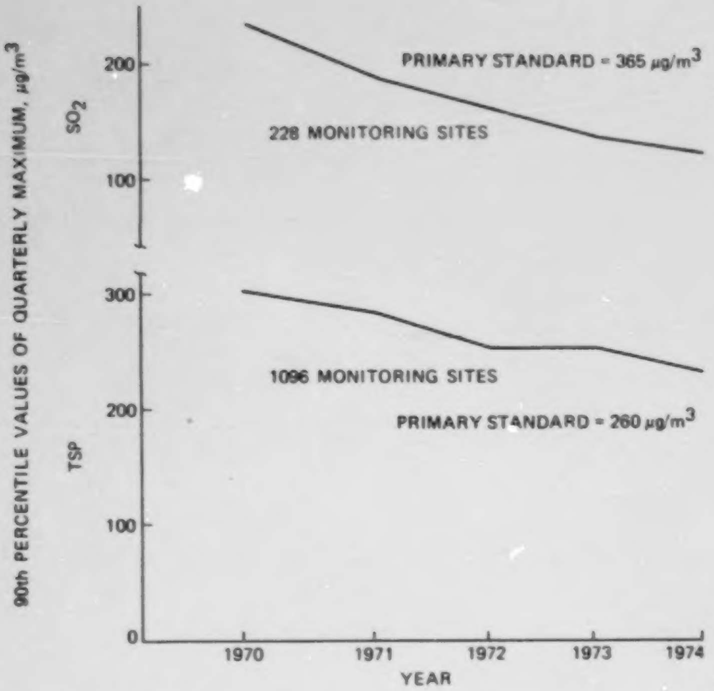


FIGURE II-18. Overall national trends in daily observed levels of sulfur dioxide and total suspended particulates (Source: U.S. Environmental Protection Agency)[8]

Carbon Monoxide

Carbon monoxide (CO) in the air is due almost entirely to emissions from automobiles. High levels of CO are related to vehicle congestion and local meteorological conditions. Deep street canyons between high buildings in cities, calm weather, and traffic jams combine to cause frequent high concentrations of carbon monoxide on a localized scale.

Figure II-20 presents an analysis of 1974-1975 CO levels in eight regions. A major problem appears in attempts to compare CO data from city to city because of differences in the location of the sampling equipment with respect to height and distance from the street. With the exception of the New York City site, we chose for this analysis stations where equipment locations were similar.

The New York City location of the sampling probe was at 8 feet above the curb; all other sites measured CO at heights of 8 to 18 feet, but at the building face several feet back from the curb. One would expect that if the New York measurements were made at the building face, as in other cities, the measured CO levels and their frequencies

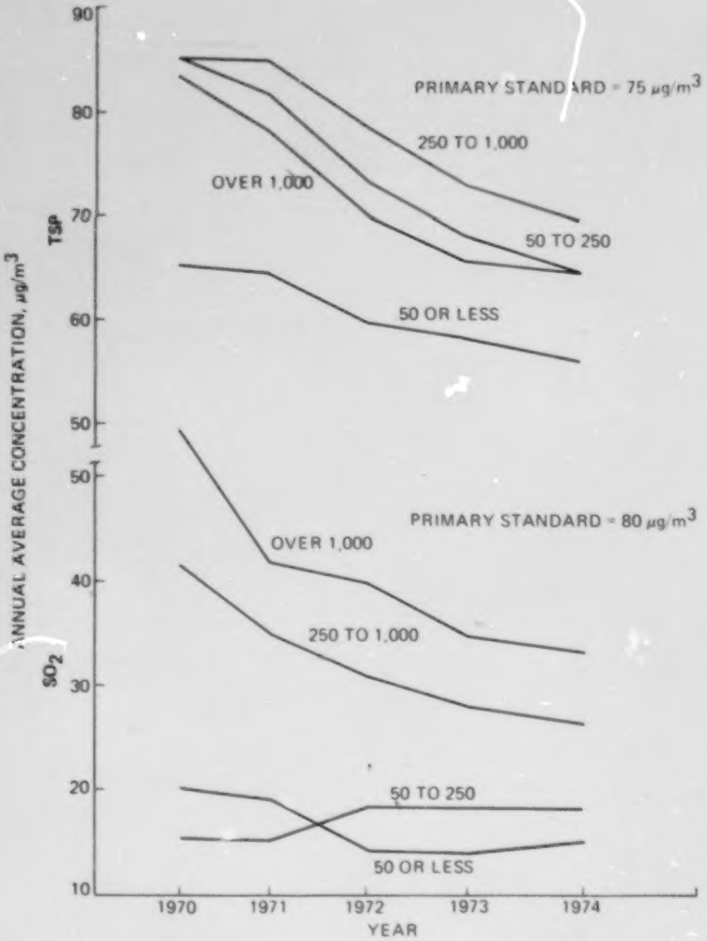


FIGURE II-19. Trends in mean annual observed levels of sulfur dioxide and total suspended particulates relative to population (population in thousands) (Source: U.S. Environmental Protection Agency) [n]

of occurrence would be somewhat lower. Mobile monitoring data taken by the local New York agency support this conclusion.

A comparison of maximum observations only would lead to the conclusion that impacts of CO are about the same in the downtown areas of most major cities in the country. When the frequency of occurrence and level of concentration are included, a different picture emerges. Taking into account the possible bias caused by monitoring differences, it still appears that most cities have a problem much less severe than that of New York. The street canyon effect, together with

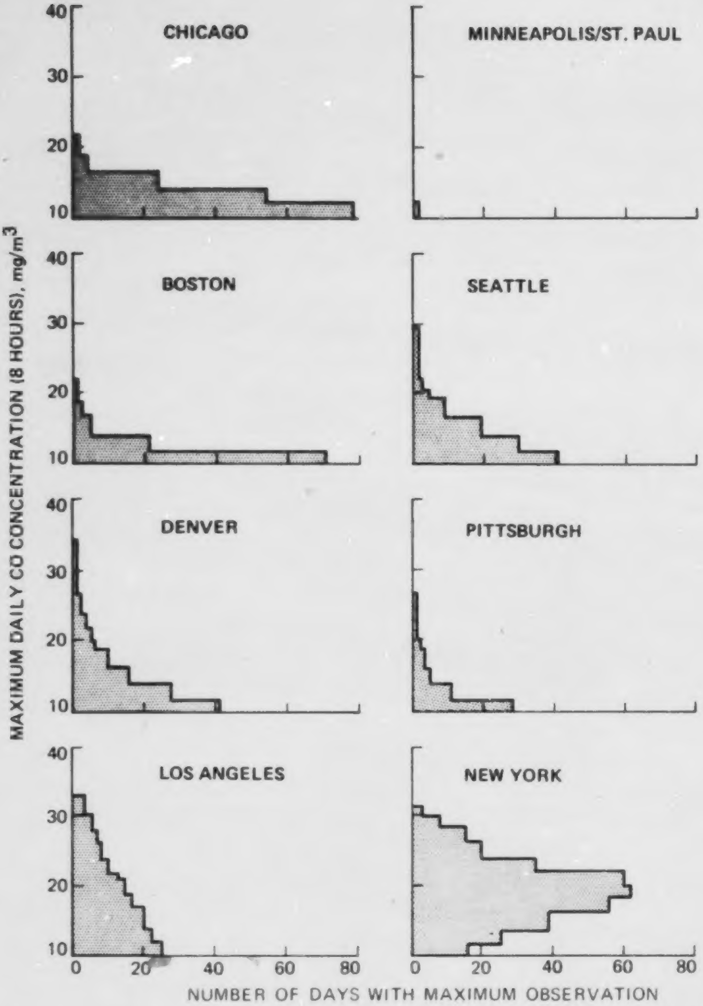


FIGURE II-20. Distributions of carbon monoxide levels for eight cities

heavy and continuous traffic congestion, creates exceptional problems in central Manhattan.

These data suggest that current and even future tailpipe emissions limits may not solve this unique localized problem. In Manhattan and other particularly congested locations, carbon monoxide emissions may be higher than indicated by the standardized EPA emissions test which assumes an average commuter speed of 18 mph.

Have the federal motor vehicle emissions standards been effective in reducing carbon monoxide pollution? To make such a determination, analytical techniques must be developed that are sensitive to short-term changes over a few years. The techniques used in the following analysis partially fulfill this need. Events such as the single-maximum, or other single 8-hour-observation in any given year are an inadequate basis for observing trends and comparing them among regions.

Figure II-21 shows the results of one CO trend analysis technique. The curves show the distribution of maximum daily 1-hour concentrations. A downward trend in the frequency of high observations is apparent in all regions except Los Angeles, although the magnitude of change differs in different regions.

The failure in Los Angeles to achieve the downward trend observed in other cities probably relates to increases in auto traffic in the vicinity of the sampling station used for this analysis. This increase apparently offset any expected decreases due to emissions control. Trijonis et al. of Caltech's Environmental Quality Laboratory[52] showed different results, finding significant overall reductions

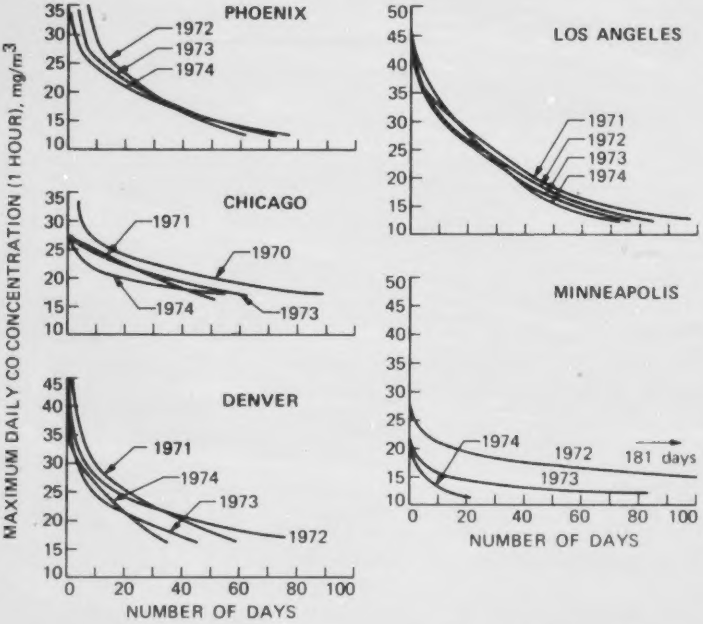
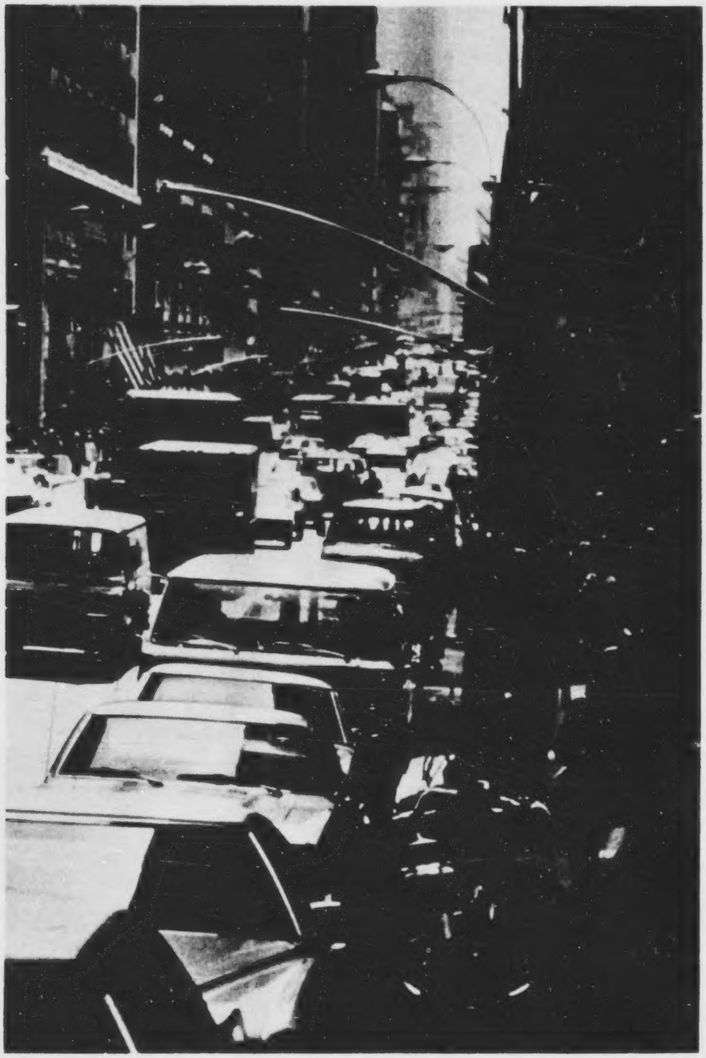


FIGURE II-21. Trends in levels of carbon monoxide for five cities

of carbon monoxide levels in the Los Angeles Basin. Although the station-by-station variation was great, from 1965 to 1975 the average reduction at all monitoring sites was 23 percent.



This photo of Lower Manhattan in New York City shows the characteristic street canyon effect created by the tall buildings. This effect, coupled with extreme traffic congestion, creates one of the worst carbon monoxide pollution problems in the United States (Photo credit: U.S. Environmental Protection Agency—Documerica, Charles Higgins)

The dramatic decrease in Minneapolis is due to a marked improvement in traffic flow in the downtown area and the addition of a thruway.

Reasons for the decrease in the upper levels of CO and the increase in lower level concentrations in Phoenix cannot be explained with certainty. Factors other than reduction in tailpipe emissions can influence the trends in an upward or downward fashion. Examples of such factors are abrupt changes in traffic density caused by roadway expansion or restriction, changes in traffic flow control, and fluctuation in private vehicle use.

The trends analysis in this section is based on data for the maximum concentration of CO for 1 hour, rather than on 8-hour average levels, which are used for designing air pollution control strategies. However, data based on the 1-hour concentration will correlate well with the data for the 8-hour average. In the future, our trends analysis will be based on data for the 8-hour average.

Ozone

Ozone is the predominant chemical constituent in the family of compounds called photochemical oxidants. For discussion purposes they are considered synonymous. Hydrocarbons and nitric oxide emitted both by automotive and stationary sources participate in the complex atmospheric reactions that form ozone as a product. Figure II-22 shows the profile of the ozone problem for eight cities. The difference is obvious between ozone levels in the southern California Basin and urban centers in the rest of the country. Although the maximum level measured is similar in most cities, the frequency of pollution occurrence differs significantly.

The ozone situation in southern California is no more typical of the nation as a whole than is New York's CO problem. Unique control programs must be developed for the Los Angeles area.

It is not possible at present to analyze national ozone trends in the same way as trends for other pollutants because the data are insufficient. With the exception of California, few regions have measured ozone for more than 2 or 3 years. For Los Angeles, Figure II-23 displays the generally downward 5-year trend, especially at the higher concentrations, for measured total oxidants. This is verified by analyses performed by Caltech (Figure II-24),[52] the Los Angeles Air Pollution Control District (Figure II-25),[53] and other agencies, as shown in Figure II-26.[54]

We have no explanation for the leveling off observed in Los Angeles and the possible slight negative trend in San Francisco over the past 3 years. Future observations will have to determine whether this neutral trend is real and/or temporary.

Trends data will begin to emerge for many other regions in the next 2 to 3 years. In the future CEQ will use techniques for ozone that are similar to those used for the other criteria pollutants.

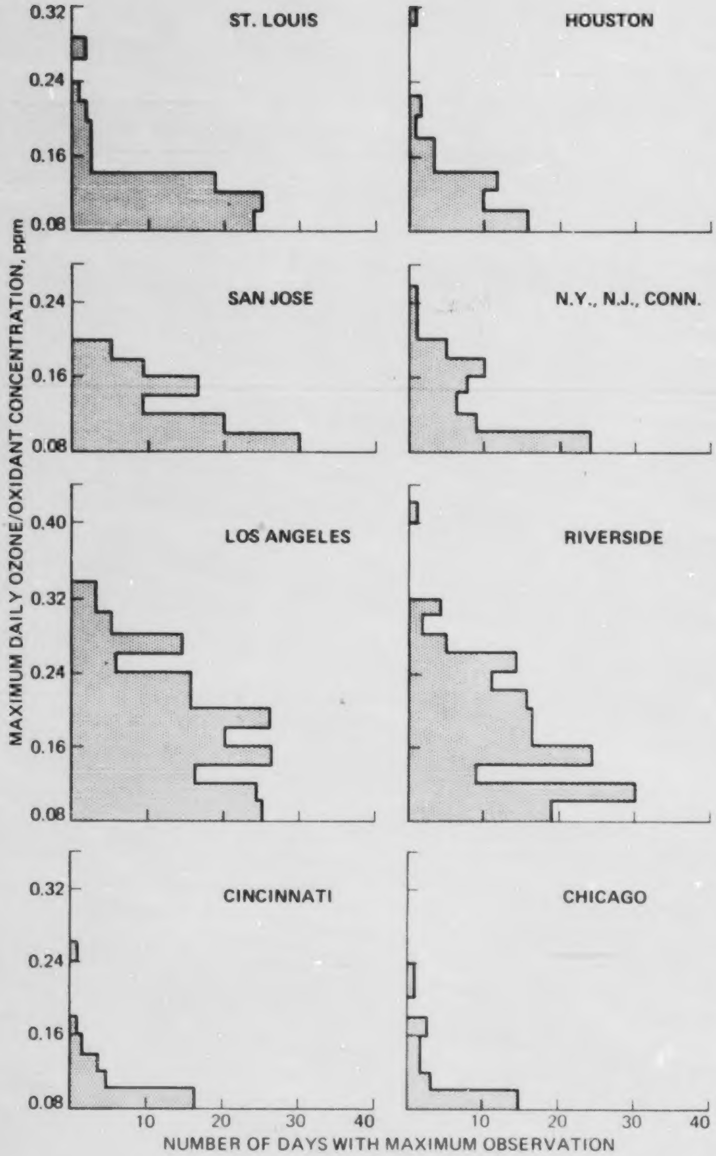


FIGURE II-22. Distributions of ozone/oxidant levels for eight cities

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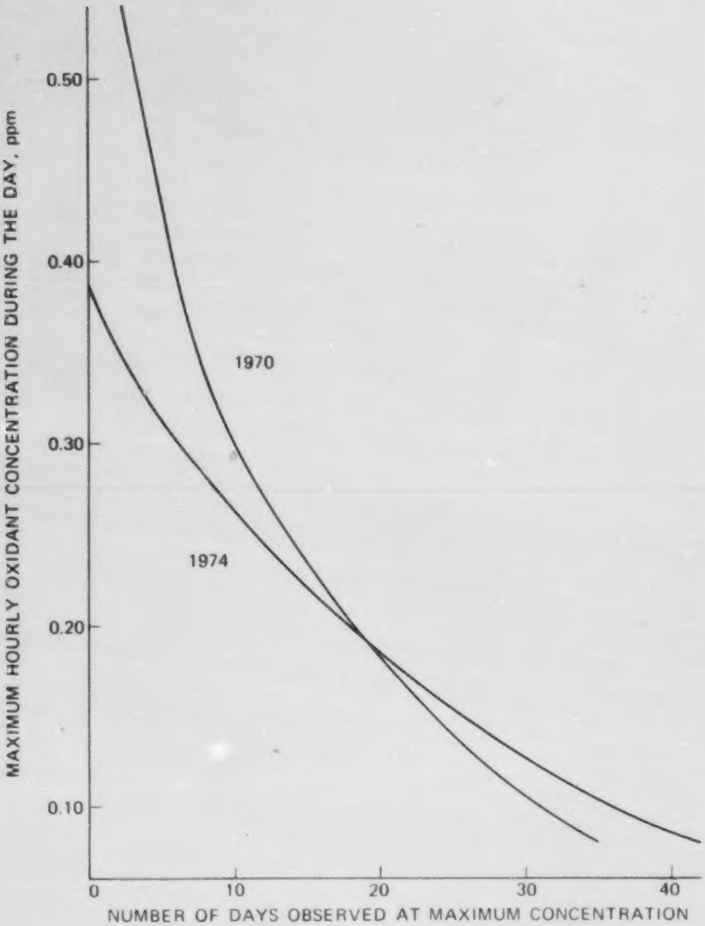

FIGURE II-23. **Trends in oxidant concentration and frequency of observation in Los Angeles (Azusa)**

Nitrogen Oxides

Nitric oxide, the main nitrogen-based compound emitted from both mobile and stationary sources, causes pollution in two ways. As nitric oxide, it participates in photochemical oxidant formation; when converted to nitrogen dioxide (NO_2), it is harmful to human health. Current regulatory programs are directed at this health aspect of the problem. Few regions in the nation violate the NO_2 primary standard, which sets allowable levels on an annual average basis. Table II-8 lists the regions that presently exceed the annual stand-

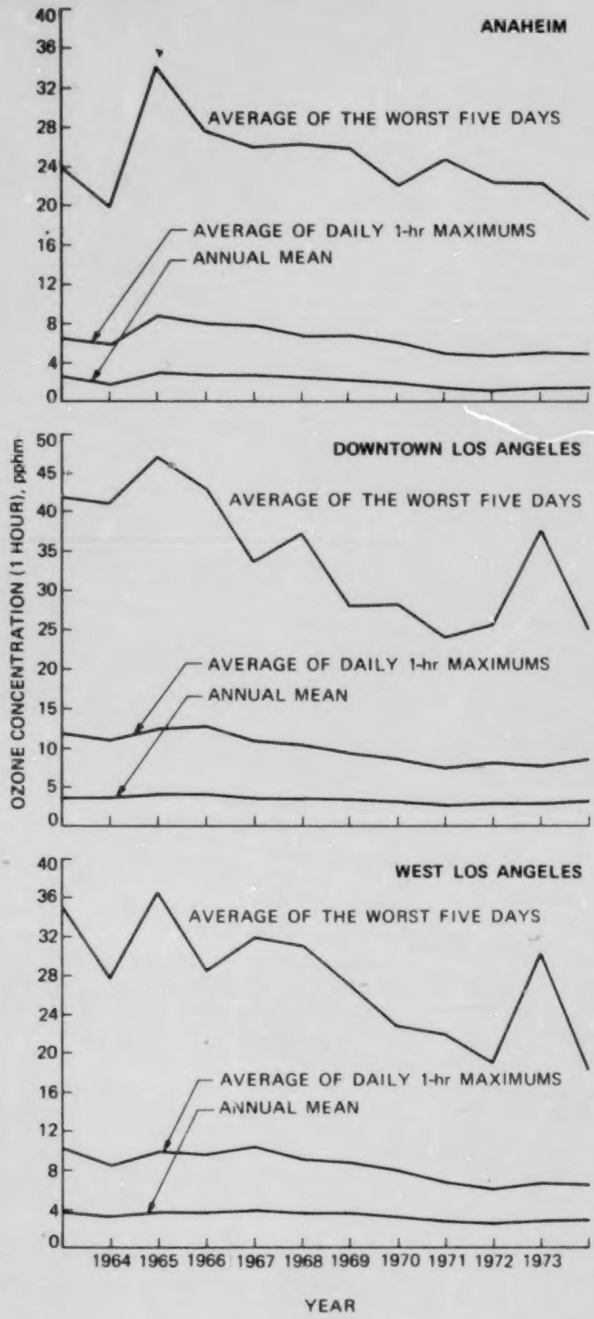

FIGURE II-24. Details of oxidant air quality trends.[88]

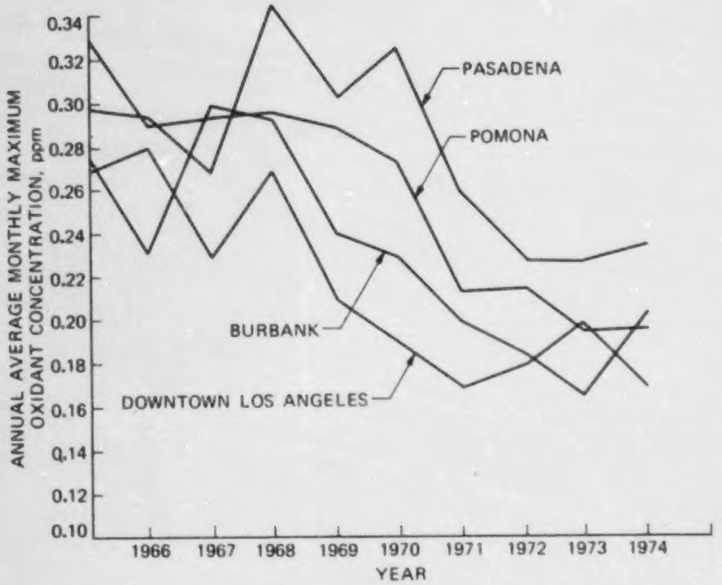

FIGURE II-25. **Ambient air quality trends for oxidants measured at three stations in Los Angeles County** [59]

TABLE II-8. Urban regions with measured air quality for nitrogen dioxide in the range of the national ambient air quality standard (Annual standard = 100 μg/m³) [60]

Urban region	Annual average concentration, μg/m³	Urban region	Annual average concentration, μg/m³
Los Angeles, California	166	**Canton, Ohio**	113
Denver, Colorado	98	**Atlanta, Georgia**	90
New York	121	**Springfield, Massachusetts**	111
Philadelphia, Pennsylvania	94	**Youngstown, Ohio**	96
Chicago, Illinois	133	**Steubenville, Ohio**	98
Baltimore, Maryland	120	**Boston, Massachusetts**	128

ard or are sufficiently close that increases in emissions may lead to standards violation.

New health effects information may lead to the setting of an additional short-term, 1-hour primary standard.[55] Assuming that allowable levels for the short-term standard will be no less than four times the annual standard, indications are that it will be achieved by present controls on NO_2 emissions, except perhaps in 12 regions. Table II-9 lists hourly observed NO_2 air quality data for these regions. Seven of the 12 regions are those already identified in Table II-8 as in violation or close to violation of the current annual standard.

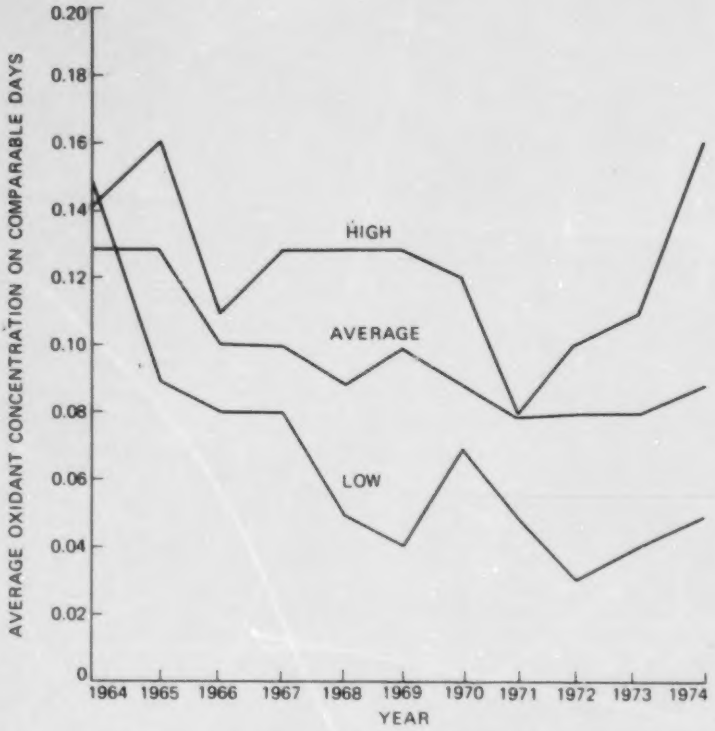

FIGURE II-26. Trends in measured levels of oxidants in the San Francisco Bay region [34]

TABLE II-9. AQCRs that may experience violation of a short-term NO_2 standard of 400 $\mu g/m^3$ or greater [a]

Air Quality Control Region	99th percentile value of observed level, for 1 hour	Hourly maximum observed
1. Los Angeles, California	432	620
2. Denver, Colorado	282	790
3. San Francisco, California	263	545
4. Washington Metropolitan	193	650
5. Atlanta, Georgia	216	470
6. Chicago, Illinois	244	414
7. Louisville, Kentucky	188	733
8. Springfield, Connecticut	338	526
9. St. Louis, Missouri	207	414
10. New York, New Jersey, Connecticut	244	526
11. Philadelphia, Pennsylvania	188	432
12. Allentown, Pennsylvania	128	639

[a] Data from monitoring station employing federal reference method and where at least 6,000 hourly observations were recorded during 1974.

There is a great deal of uncertainty about the available NO_2 monitoring data because of measurement problems. EPA is still in the process of defining an acceptable method for monitoring nitrogen oxides (NO and NO_2). Because of uncertainties connected with the promulgation of the short-term standard, coupled with unreliable data, it is difficult to make projections on attainment of primary standards for NO_2. However, because of the recently adopted controls on automobile emissions, it appears that all but two or three regions will, within a few years, meet the existing annual standard or any short-term standard likely to be set.

EMISSIONS TRENDS

All of the discussion so far has focused on ambient air quality. But our pollution control strategies are directed at reducing pollutant emissions. It is important, both at the national and local levels, to make routine comparisons of emissions estimates with air quality data, thus testing the effectiveness of these control strategies.

EPA at present collects annual nationwide estimates on tonnage of air pollution emissions, and trends in these data reflect the broad impact of imposed control strategies. Such gross trends, however, cannot be compared easily to local air quality trends. With few exceptions, nationwide emissions data are not broken down and reported on a regional or local basis. Such data, when compared with local air quality monitoring data, could provide valuable insights on the effectiveness of control strategies, even at the individual plant level. For example, extra efforts to reduce SO_2 emissions from smelters and coal-fired powerplants would be evident by trends in the air quality data collected in the vicinity of such sources.

Burning of fossil fuel, either in stationary or automotive combustion systems, contributes most of the SO_2, TSP, CO, and NO_x emissions. Hydrocarbon (HC) emissions come from both combustion sources and processes where HC evaporation can occur, such as gas station operations, i.e., filling of storage tanks, pumping of gas into cars, etc. Figures II-27 and II-28 show national trends in emissions for all of these pollutants.[56] The downward trend in HC and CO is a reversal of the uncontrolled growth of these emissions before 1970 and reflects the influence of emissions controls on automobiles. Examples of emissions trends on a local scale are shown in Figures II-29 [57] and II-30 [58] for HC and CO emissions for the Los Angeles Basin; they are similar to the national trends. Several years hence, marked effects from automotive emissions control should also become apparent for nitric oxides.

The slight increases in NO_x levels reflect the fact that the technology used to control HC and CO in the 1968-1972 model cars caused increased NO_x emissions per car. The addition of exhaust gas recirculation in model years 1973 and 1974 and the advent of the catalytic converter (thus eliminating the controls which increased NO_x emissions) in 1975 began to reduce overall NO_x emissions. NO_x

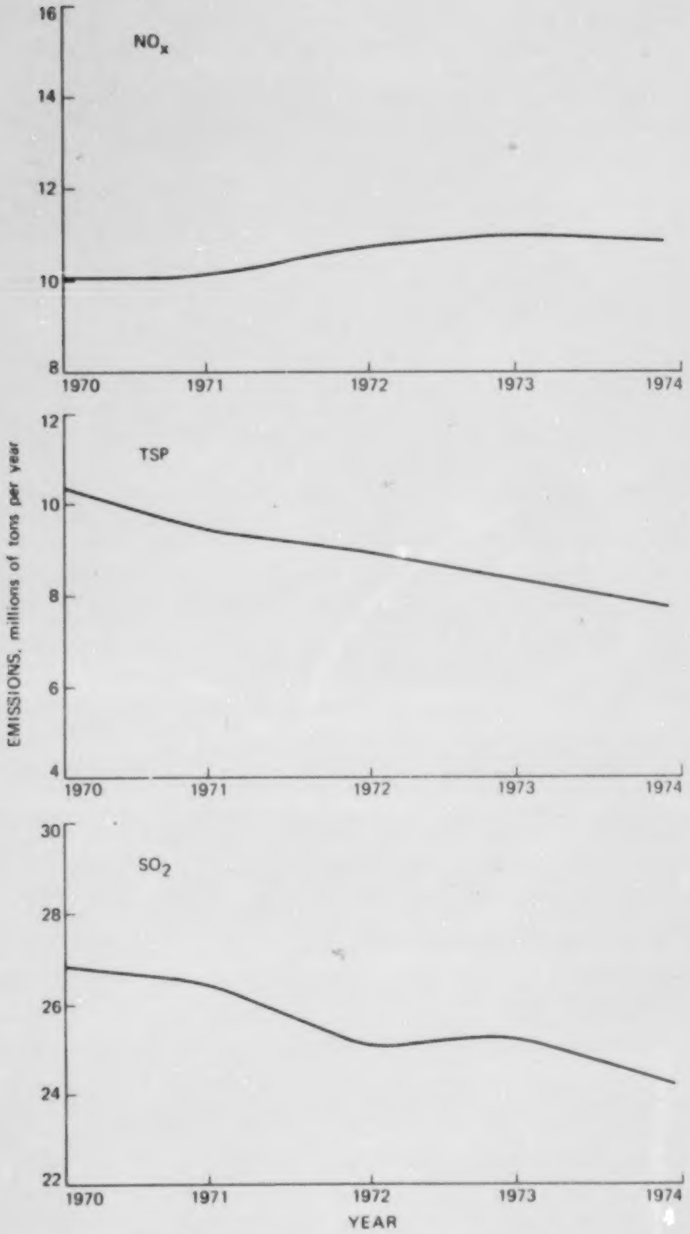

FIGURE II-27. **Emissions trends in the stationary fuel combustion sector** [illegible]

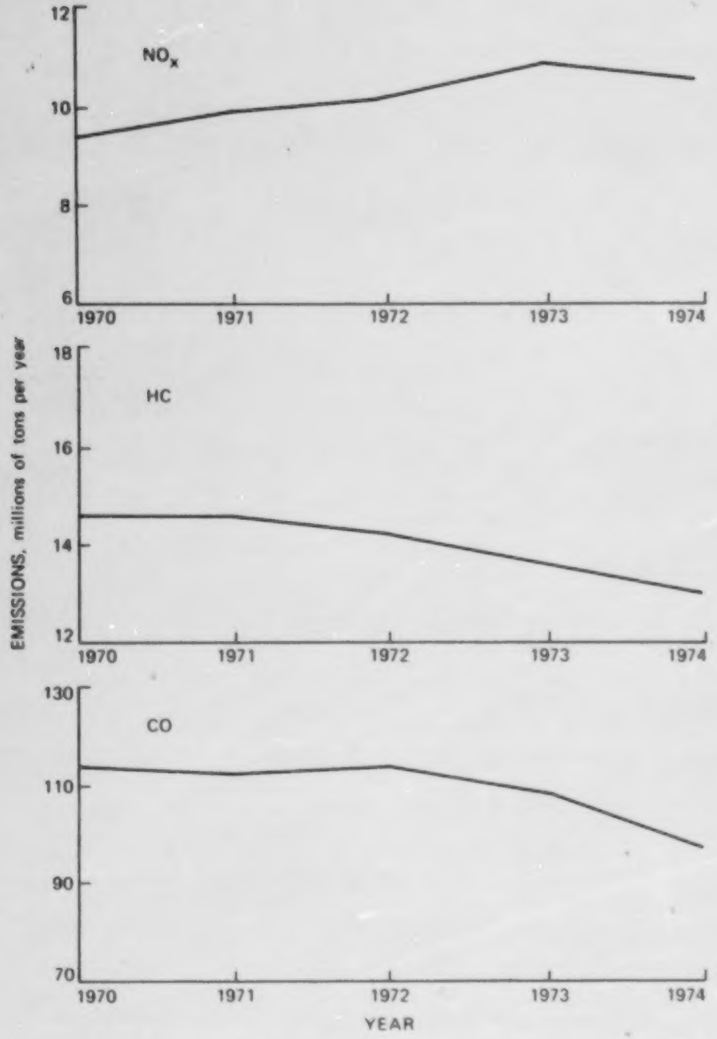

FIGURE II-28. Emissions trends in the transportation sector[58]

emissions in catalyst-equipped cars are about half those from the 1968-1972 cars. Nationwide NO_x emissions from all mobile and stationary sources combined have not changed over the last several years. Locally, however, control efforts have brought about considerable reductions. In some gas and oil-fired powerplants, combustion control techniques have reduced NO_x emissions from 30 to 50 percent.[59]

Combustion control has had the greatest application in southern California, where NO_x levels are severe, and has served to counter-

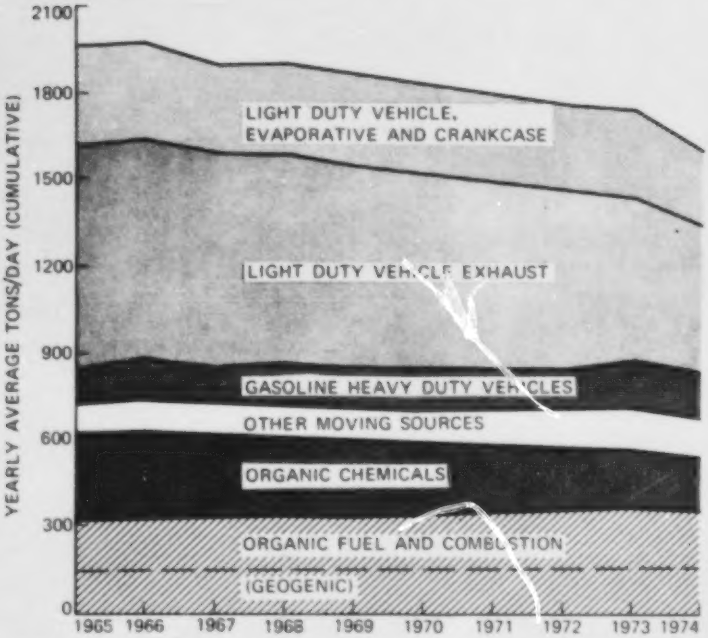

FIGURE II-29. South Coast Air Basin reactive hydrocarbon emissions trends[69]

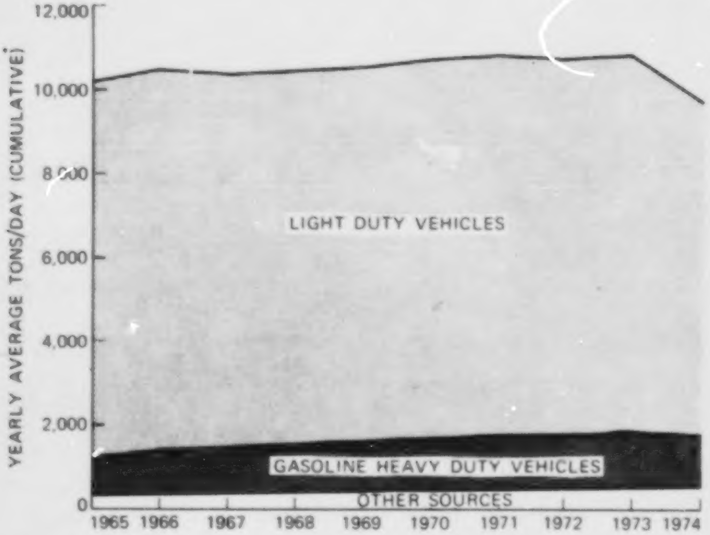

FIGURE II-30. South Coast Air Basin carbon monoxide emissions trends[69]

act the rapid growth of automobile NO_x emissions occurring there in the late 1960's. Rapid growth in the vehicle population and the higher NO_x emissions from 1968-1969 model year cars, coupled with a natural gas shortage, caused the NO_x emissions to rise again after 1970, as shown in Figure II-31.[60] A reversal of this trend can be expected as the in-use vehicle population changes to include more automobiles with lower NO_x emissions.

The control of HC emissions is necessary to reduce atmospheric levels of ozone and other oxidants. At present, the national emissions inventory attributes half of the human-made hydrocarbons emissions to motor vehicles and the rest to various stationary sources. The proportions of each source may vary from 30 to 70 percent among the major urban regions of the country. As shown in Figure II-32, the share from motor vehicles is moving downward as a result of the emissions control program, while emissions from stationary sources are not declining.[51] In fact, they are increasing in some sectors. Achievement of the ambient ozone standard will depend upon increased control of stationary sources in most of the major urban regions of the country.

A recent interagency study headed by EPA projected air quality in relation to various automobile emissions control strategies.[61] Figure II-33 shows projections of CO levels for 3 of the 26 cities analyzed under three possible degrees of emissions control. These projections assume that nationwide inspection and maintenance pro-

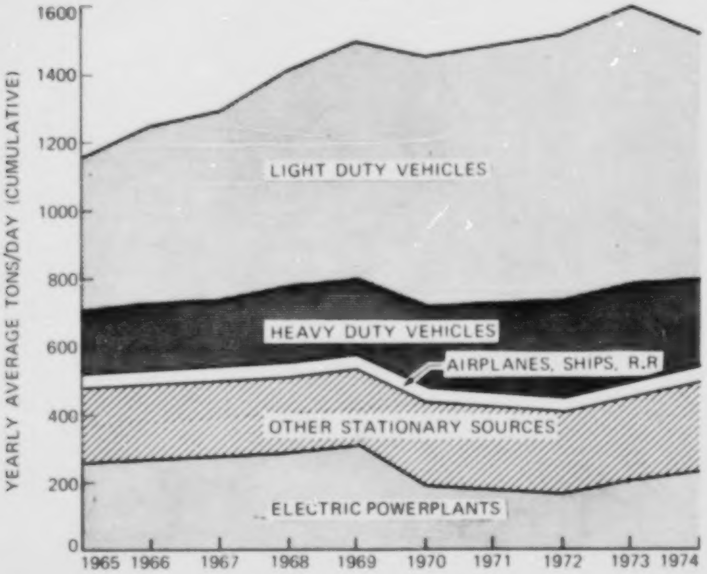

FIGURE II-31. South Coast Air Basin nitrogen oxide emissions trends

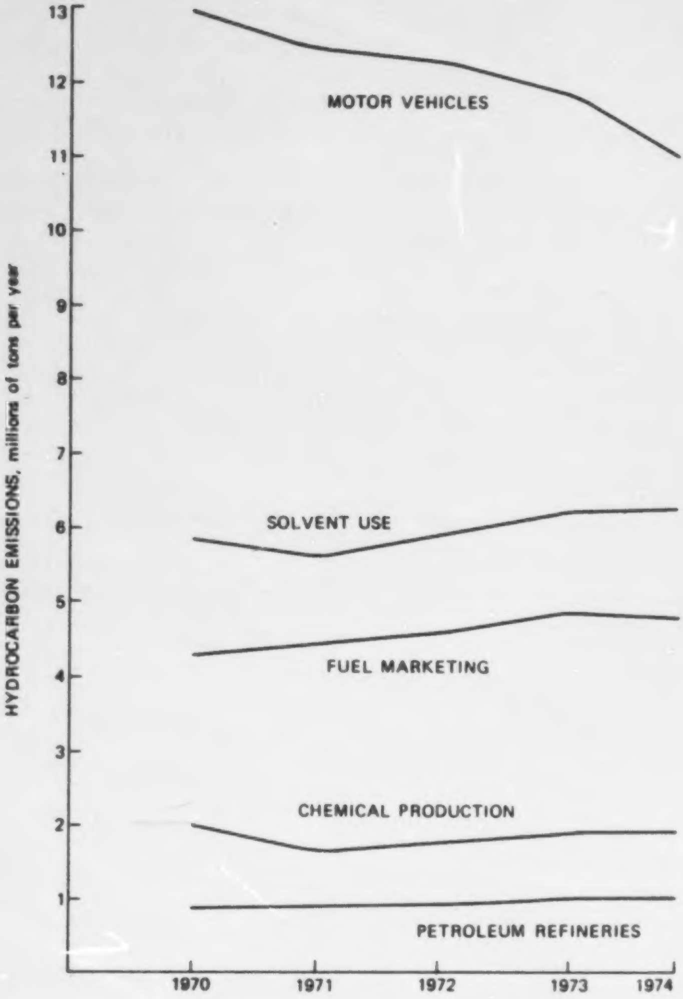

FIGURE II-32. Trends in hydrocarbon emissions in the nontransportation sectors in comparison to motor vehicle emissions[81]

grams will ensure that the average in-use vehicle meets the emissions levels indicated.

Two conclusions may be drawn from the EPA data. First, most cities will meet or come close to meeting the CO standards between 1980 and 1985. Second, differences in prospective tailpipe emissions limits do not greatly influence the projected year when the CO standard will be met. For example, if the current 49-state emissions stand-

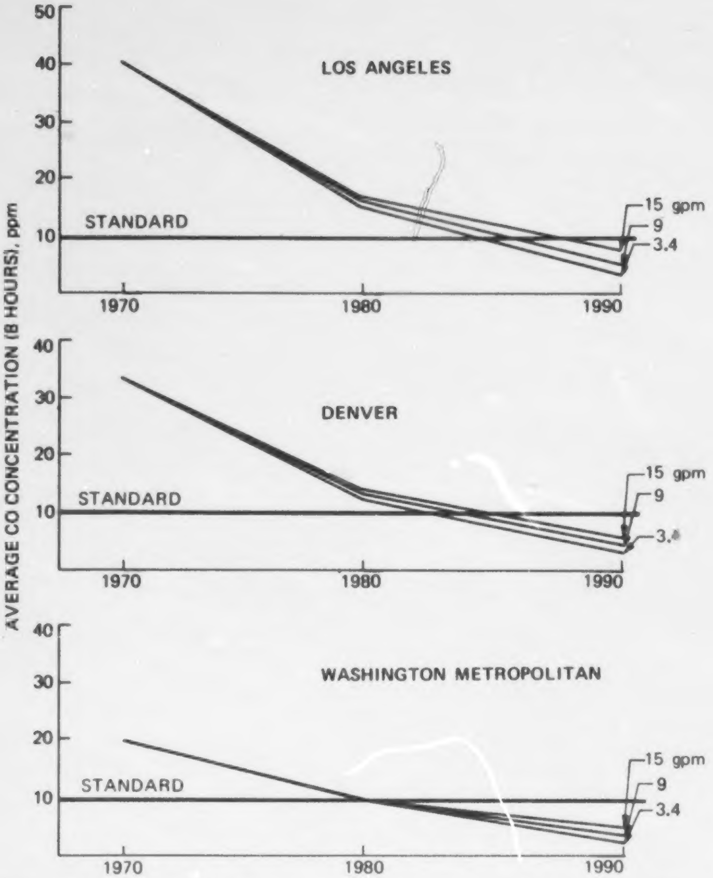

FIGURE II-33. Projections of carbon monoxide levels in three urban regions for various emissions control limitations

ard of 15 grams per mile (gpm) were retained, achievement of the air quality standard might be delayed a year or two and, until then, CO concentration in the air would be only 1 to 3 ppm higher than if the 3.4-gpm standard were in effect.

The two-dimensional diagram used to describe existing air quality can also be used in air quality projections. Assuming a 15-gpm emissions standard, the EPA study projects a net average 55-percent reduction in CO emissions between 1973 and 1980. Using these estimates for emissions reductions, the right-hand column of Figure II-34 shows two-dimensional projections of CO air quality for seven of the eight cities shown in Figure II-20. The middle column shows a second case, which assumes only a 30-percent reduction in CO emissions. This series of diagrams also represents the interim air

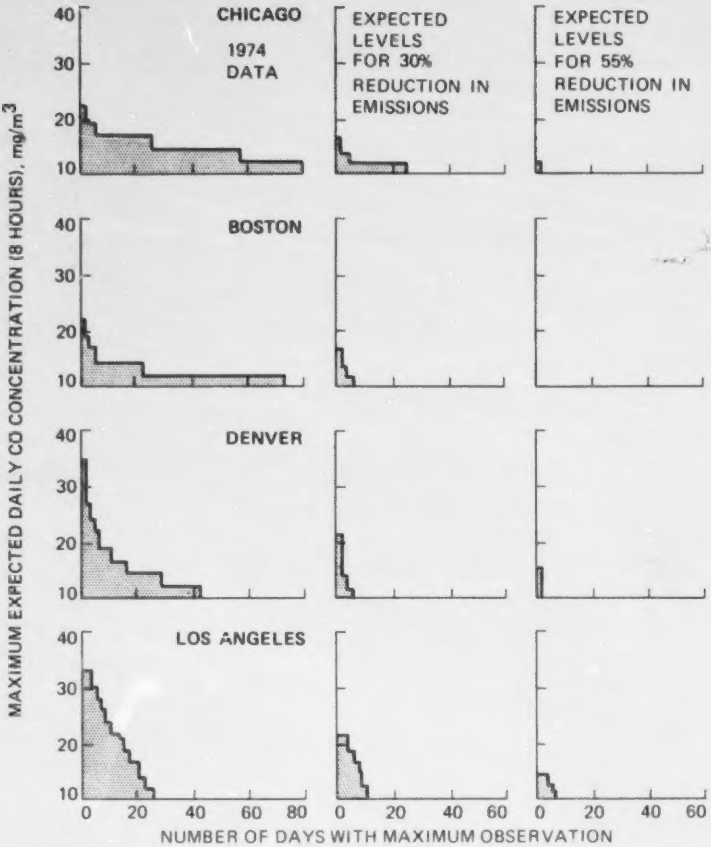

FIGURE II-34. **Projections of maximum expected daily carbon monoxide concentrations for two levels of emissions reductions**

quality levels to be expected between now and 1980 if the 55-percent reduction is achieved. The significance of the residual CO problem in New York is evident; CO would also persist in Los Angeles, but to a lesser degree.

Estimates of anticipated emissions and future air quality involve a high degree of uncertainty, partly because of our limited understanding of the relation between emissions and air quality. The potential for error in estimating growth factors, changes in economic and social patterns, and new technology developments is also large. Nevertheless, analysis based on projections is an important element in assessing current air quality control strategies and in planning future strategies.

The same type of analysis for ozone pollution is shown in Figure II-35, which shows best- and worst-case estimates for expected ozone

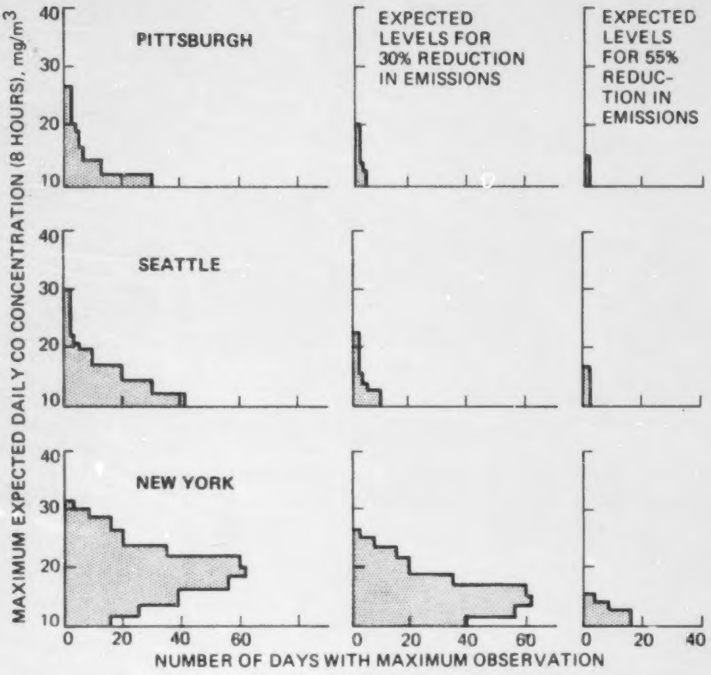

FIGURE II-34—Continued

profiles that will emerge during the 1980-1985 time frame. These projections assume that any reduction in HC emissions will produce a proportionate reduction in observed ozone concentration. Factors affecting projected hydrocarbon emissions and their associated ozone levels include the proportion of HC emissions caused by cars, other mobile sources, and stationary sources, on a region-by-region basis; the level of control for each category of source; the durability of pollution control devices; and the growth of all emitting sources.

Another important factor is the assumed relationship between HC emissions and the levels of ozone they cause. A great deal of controversy exists in the scientific community concerning this relationship. For the present, we have assumed a direct proportional relationship in the absence of more definitive data. The recent trends analysis by Trijonis et al. for the Los Angeles Basin tend to support this assumption.[52] Their data show that HC emissions were reduced by an estimated 18 percent over the past decade. Oxidant air quality over the Basin improved by 19 percent, on the average. Laboratory studies in smog chambers also support the one-to-one relationship between HC emissions and oxidant air quality.[61]

The range of estimates of future HC emissions reduction depends upon assumptions made about the factors discussed above. The

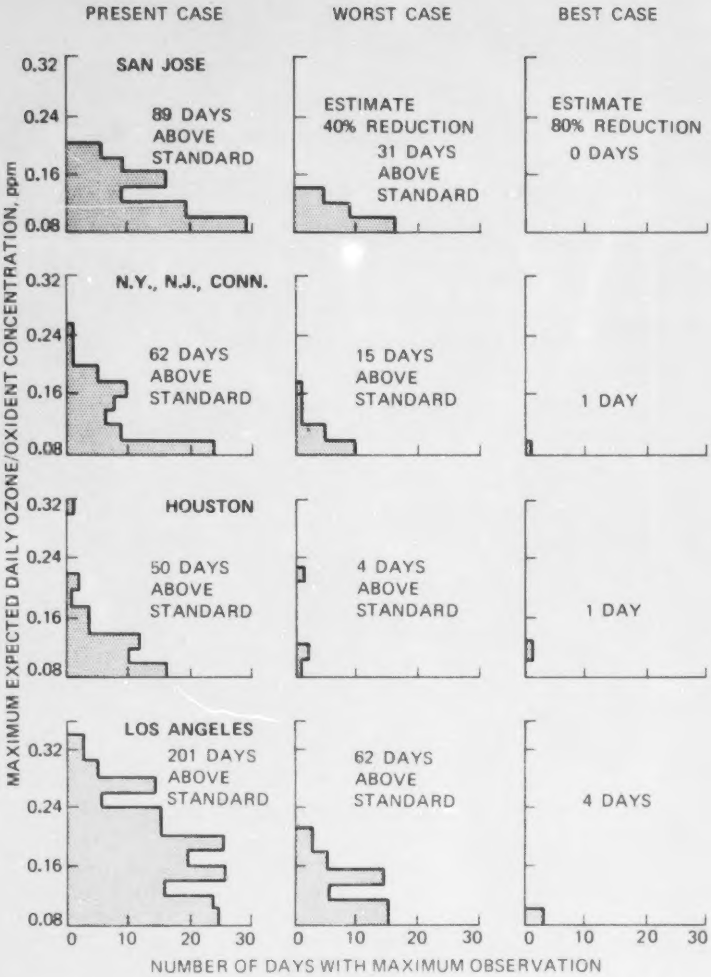

FIGURE II-35. Projections of maximum expected daily ozone/oxidant concentrations for estimated best- and worst-case conditions of hydrocarbon emissions reductions

actual outcome for each AQCR over the 1980-1985 time period will probably lie somewhere between the expected ozone reduction of 40 to 80 percent. The seven cities shown in Figure II-35 are representative of regions with the nation's most severe ozone problems. The analysis indicates that, by 1985, ozone levels above the standard are highly probable only in Los Angeles. If adequate attention is given to controlling hydrocarbons from stationary sources, and appropriate enforcement of emissions controls for autombiles is undertaken, the net

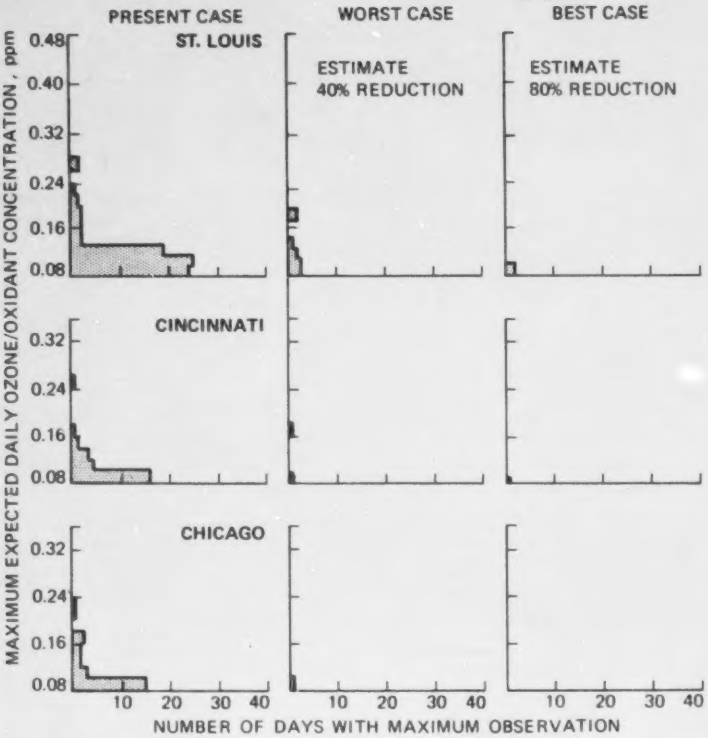

FIGURE II-35—Continued

emissions reduction could approach the best case, that is, 80-percent improvement. For all practical purposes, if this occurs, the ambient standards for ozone can be met by 1985. Monitoring is essential to test the validity of the assumed relationship between emissions and air quality and to check the effectiveness of concomitant control strategies. Measurement of changes in ozone air quality and changes in the aggregate emissions from the fleet of vehicles in use over the next several years must both be observed carefully.

AIR QUALITY INDICES

Recommended Air Pollution Index

Air pollution levels in the nation's cities change from day to day, mostly as a result of meteorological conditions and some variation in emissions from mobile and stationary sources. Daily levels of air pollution in excess of health standards are of particular interest to persons suffering from illnesses that are aggravated or caused by air pollution.

Most of the daily information about urban air pollution levels is compiled by state and local agencies and reported to the public by the news media. In recent years, dozens of public reporting methods have been developed for this purpose, and millions of Americans have become familiar with hearing reports of daily *air pollution index* values.

Because of the large amount of information being communicated to the public and the special importance of this daily information to many citizens, CEQ and EPA conducted a study last year to evaluate the scientific validity and information value of the air pollution indices being reported in the nation's major cities.[62] The findings of this study were quite disturbing. A confusing and scientifically inconsistent array of daily reporting methods was found to be in current use. At least 14 basically different kinds of indices are used, and many of them fail to provide truly meaningful information to the public.

To improve the situation, CEQ established in summer 1975 a Federal Interagency Task Force on Air Quality Indicators, consisting of representatives from CEQ, EPA, the National Oceanic and Atmospheric Administration, the National Bureau of Standards, and the Department of Commerce. The primary mission of the task force is to develop and recommend a standardized air pollution index for uniform nationwide reporting. The task force has published a draft report containing their recommendations.[63]

The task force developed a candidate index, the *Pollutant Standards Index* (PSI), which is based on several key design criteria:

- Easily understood by the public.
- Includes the existing criteria pollutants and is capable of including future pollutants.
- Relates to ambient air quality standards.
- Relates to federal episode prevention criteria.
- Can be calculated simply.
- Is consistent with perceived air pollution levels.
- Uses existing monitoring systems as much as possible.
- Can be forecast a day in advance as an option.

The candidate PSI includes five pollutants: CO, SO_2, TSP, oxidants (or ozone), and NO_2. The National Ambient Air Quality Standard (NAAQS), Federal Episode Criteria, and Significant Harm Levels exist for all five. One pollutant product, $SO_2 \times$TSP, is included because it has both Federal Episode Criteria and a Significant Harm Level. As with NO_2, which has no short-term primary NAAQS, the $SO_2 \times$TSP product is only a part of the index structure when the Federal Episode Criteria or Significant Harm Levels are exceeded. The index is designed so that any pollutant identified in the future as requiring the NAAQS, Federal Episode Criteria, and Significant Harm Levels can be added without modifying the basic form of the index.

Table II-10 presents all of the elements and method of calculating the index.[63] For example, PSI (ψ) equals 100 for each NAAQS, and ψ equals 500 for the Significant Harm Levels. Another breakpoint is added below the NAAQS at 50 percent of the primary NAAQS for each pollutant, with the exception of SO_2 and TSP where the secondary NAAQS are used. This procedure provides a graduation between good air quality and marginal air quality just below the pertinent standard.

Because each pollutant is examined separately by comparing its measured concentration with the NAAQS, the Episode Levels, and the Significant Harm Level, each pollutant can be reported separately. At the minimum, the pollutant with the highest index value should be reported to advise the public of the worst air pollution levels to which it is exposed. The index values of the other pollutants should also be reported, especially if they exceed 100.

As shown in the table, five descriptor categories are used: "good," "moderate," "unhealthful," "very unhealthful," and "hazardous." These categories are related to generalized health effects language and appropriate cautionary statements. When the air pollution level is reported as "unhealthful," "very unhealthful,' or "hazardous," then the cautionary statements and generalized health effects described in Table II-10 may be used by the news media.

A pilot study performed in three urban regions—Los Angeles, Chicago, and Newark—has tested the usefulness of the recommended index as a comparative tool in evaluating national air quality. At present, comparisons must be judged with caution because the quality and completeness of the data vary across the country. Once a common data base exists, the Pollutant Standards Index will be extremely useful in making comparative assessments.

Because the summaries reflect the air pollution impact by generalized health impact categories, some level of city-by-city comparisons can be made. Figure II-36 shows the data for the three cities. Los Angeles, which has high oxidant levels in the late summer and high carbon monoxide levels in the winter, exhibits many more days in the unhealthful, very unhealthful, and hazardous ranges of the index than do Chicago or Newark, which experience only a few days of impact from a single pollutant. Annual index summaries for each pollutant permit further detailed comparisons on a region-by-region basis.

Indices that appraise the total air pollution health risk to the nation are the next step—comprehensive indicators that place the human health risk of air pollution into perspective. At present, estimated air pollution damages outweigh the costs of control, as discussed in our previous Annual Reports. Eventually, however, as we move closer to achieving environmental quality standards, we may have to make selective decisions about which pollutant in which environmental medium, such as air, water, or food, is the most important one to control. Because financial and other resources are limited, control strategy decisions must weigh the *marginal* risks against the costs of avoiding them. For example, is it more important to empha-

TABLE II-10. Comparison of ψ values with pollutant concentrations, descriptor words, general health effects, and cautionary statement[illegible]

Index value	Air quality level	Pollutant levels					Health effect descriptor	General health effects	Cautionary statements
		TSP (24 hour), µg/m³	SO_2 (24 hour), µg/m³	CO (8 hour), mg/m³	O_3 (1 hour), µg/m³	NO_2 (1 hour), µg/m³			
600	Significant harm	1000	2620	57.5	1200	3750	Hazardous	Premature death of ill and elderly. Healthy people will experience adverse symptoms that affect their normal activity	All persons should remain indoors, keeping windows and doors closed. All persons should minimize physical exertion and avoid traffic
400	Emergency	875	2100	46.0	1000	3000		Premature onset of certain diseases in addition to significant aggravation of symptoms and decreased exercise tolerance in healthy persons	Elderly and persons with existing diseases should stay indoors and avoid physical exertion. General population should avoid outdoor activity

300	Warning	625	1600	34.0	800	2260	Very unhealthful	Significant aggravation of symptoms and decreased exercise tolerance in persons with heart or lung disease, with widespread symptoms in the healthy population	Elderly and persons with existing heart or lung disease should stay indoors and reduce physical activity
200	Alert	375	800	17.0	400[c]	1130	Unhealthful	Mild aggravation of symptoms in susceptible persons, with irritation symptoms in the healthy population	Persons with existing heart or respiratory ailments should reduce physical exertion and outdoor activity
100	NAAQS	260	365	10.0	160	[a]	Moderate		
50	50% of NAAQS	75[b]	80[b]	5.0	80	[a]	Good		
0		0	0	0	0	[a]			

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[a] No index values reported at concentration levels below those specified by "Alert Level" criteria.

[b] Annual primary NAAQS.

[c] 400 $\mu g/m^3$ was used instead of the ozone Alert Level of 200 $\mu g/m^3$.

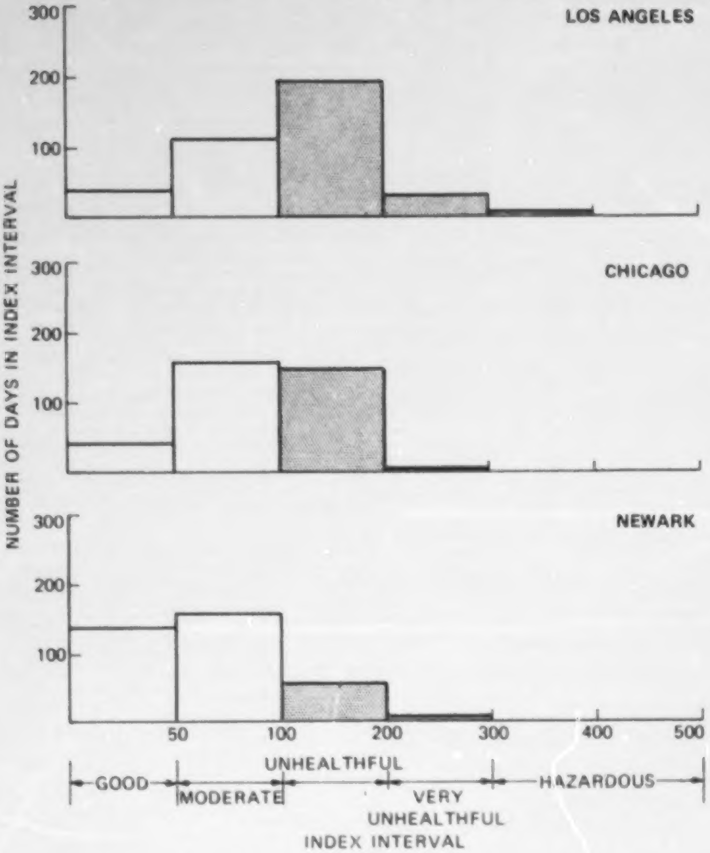


FIGURE II-36. Annual summaries of daily Pollutant Standards Index values for Newark, Chicago, and Los Angeles (1974 data)

size reducing suspended particulate levels in a great many northwestern regions from an annual average of 65 $\mu g/m^3$ to 60 $\mu g/m^3$ (the secondary standard), or to use the same resources to control ozone as much as possible in smoggy southern California? The right indicators can help to answer such questions. The ideal health risk indicator should include:

- Known health effects of each pollutant at levels above the established standards.
- Segments of the nation's population affected by each health effect.
- Severity of the impact of each health effect, that is, severe illness, mild illness, nuisance.

- Measured air quality levels in all regions of the country, including the frequency of readings above the standards.
- Variation in pollutant levels across individual regions.
- Variation in location of the sensitive population, both nationally and regionally.
- Daily movement of persons in relationship to air pollutant exposure.

There is still a great deal of work before the ideal indicator is developed. Many of the required elements cannot yet be quantified precisely. Meanwhile, best judgments should be used. Evaluations will be better, as more information becomes available, and the indicators will more accurately reflect the risks. CEQ and EPA are pursuing the development of such indicators. We will report on these endeavors in future Annual Reports.

CONTROL OF NONCRITERIA POLLUTANTS

In addition to the five "criteria" pollutants subject to current regulatory programs, several other pollutants are under special controls or are candidates for control.

Asbestos, beryllium, and mercury have been designated as hazardous pollutants, and vinyl chloride has been proposed as another. EPA has developed specific control strategies applicable to the processes that generate these pollutants; the strategies are periodically upgraded in light of new information. The manufacture of asphalt, concrete, shotgun shells, and the disposal of asbestos wastes have been added to the nine asbestos sources originally covered. The control of sewage sludge incinerators was added to the source list of mercury emissions. Recent events affecting controls for vinyl chloride and lead are discussed in Chapter I.

Several new regulatory actions by EPA are intended to effect a decrease of emissions in many industrial sectors. EPA proposed new source performance standards for six additional processes, bringing the total number of industries covered to 17. Such standards ensure that all newly constructed industrial plants use the best available emissions control technology. They focus on the control of sulfur oxides, sulfuric acid mist, fluorides, and particulates, including metals.

As for mobile sources other than passenger cars, more stringent emissions standards will soon be published regarding both light and heavy duty trucks, buses, and other vehicles. Smoke emissions control requirements for diesel-powered vehicles will be tightened. Motorcycles also have come under scrutiny, and regulations were proposed in 1975. Because of inadequacies in the measurement method, EPA has revised its test procedure for measuring the evaporative losses that now account for a large share of the total HC emissions from automobiles.

IMPACTS ON TERRESTRIAL ECOLOGY

The national air quality program is presently focused on meeting standards that protect human health.[47] Effects on the public welfare, such as vegetation damage, decreased visibility in pristine areas, damage to materials, and destruction of art objects, have received less attention in terms of setting standards. A specific secondary standard for particulates has been set as well as a guide for sulfur dioxide. For the other pollutants, such as oxidants and nitrogen oxides, EPA has set the secondary standard at the same level as the primary standard.

EPA is conducting research on the effects of air pollutants on land life other than humans. The primary purpose of the research program is to strengthen the scientific basis for air pollution control strategies directed toward effects on welfare, as mandated by the Clean Air Act. Among the first results of this work is the finding [47] that air pollutants impede natural nitrogen fixation—an effect previously unrecognized.

Atmospheric nitrogen is converted into organic form by legumes, such as alfalfa and soybeans. This conversion is an essential natural process by which nitrogen fertilizer is added to the environment. In laboratory studies to determine the influence of polluted air on nitrogen fixation, alfalfa plants were exposed to low levels of ozone and sulfur dioxide throughout the growing season.[47] The nitrogen content of the plants was used as a measure of the nitrogen fixation process. Ozone at concentrations below the primary standard reduced nitrogen fixation by 40 percent. Sulfur dioxide also significantly reduced nitrogen fixation when the median concentration exceeded 0.06 part per million (ppm), which is approximately twice the annual primary standard.

Other preliminary results show that sulfur dioxide and photochemical oxidants substantially inhibit growth of selected crops.[47] Crops in the field were subjected to varying concentrations of the pollutants, simulating real air quality conditions as measured at selected sites. Results of the research, which began in 1975, are being used to improve economic loss assessments.

Cadmium is a ubiquitous element in the Earth's crust, and small amounts can be found in almost all plants. EPA studies, however, show that large cadmium compound residues have detrimental effects.[47] Cadmimum compounds seem to inhibit both plant growth and nitrogen fixation. Cadmium oxides, chlorides, sulfates, sulfides, and phosphates are toxic to many plants and animals. Sources of these compounds include automobile emissions, tire residues, coal-fired powerplants, and parent rock material from which phosphate fertilizers are produced.

Preliminary research results show that cadmium and selenium pollutants adversely affect the rate at which dead organic matter decomposes and its nutrients are made available for plants. Studies also indicate that some organisms, such as mites, which aid decomposition, may be forced to migrate from their normal litter habitat when subjected to sulfur dioxide exposure.[47] Ozone is capable of reducing ammonia nitrogen, thus decreasing the nitrogen pool in some forest soils, and possibly affecting tree growth.

WATER QUALITY

Before the 20th century, we judged water quality almost entirely by unaided human senses and usually classified it according to water sources typical of the time, such as spring water, swampwater, bilgewater, and stumpwater. The main criterion for judging quality was whether the water was fit to drink. It should be noted, however, that "fit to drink" meant something different in those times, when mortality rates of 10 to 100 per 100,000 persons per year due to water-borne disease were commonplace.

Since the turn of the century, we have identified many factors in addition to pathogenic microorganisms that can make water unfit to drink. We have also become more concerned about aspects of water quality other than potability. In modern terms, water quality is related to the suitability of water for specific beneficial uses. Water quality is measured directly by chemical, physical, and biological variables. The number of variables needed to determine the suitability of water and the acceptable ranges of those variables depend on the specific water use, such as drinking, swimming, aquatic life protection, irrigation, or industrial supply.

Under the 1972 amendments to the Federal Water Pollution Control Act, the United States has adopted a goal of restoring and maintaining ". . . the chemical, physical, and biological integrity of the nation's waters."[64] These amendments have established an interim goal of achieving water quality which ". . . provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water . . . by July 1, 1983."[64]

Implementation of the 1972 amendments has brought about stringent controls on many industrial and municipal point-source wastewater discharges, but the more formidable task of controlling nonpoint sources of pollution is barely underway. Nonpoint sources include surface runoff from urban and agricultural land, the entry of air pollutants into waterways through dry fallout, precipitation and soil runoff, and many other diffuse sources.

Point sources have usually been responsible for the most severe local water pollution problems. Nationwide, however, the quality of our waters is affected more broadly by nonpoint sources and natural factors, such as geology and climate, than by point-source discharges. Although point-source abatement is essential and has been beneficial, there is a serious doubt that point-source controls alone, for many U.S. waterways, can prove adequate to reach the water quality goals established by law.

Recreational use of the nation's waters is an important water quality goal for millions of Americans (Photo credit: A&D Muir, Ltd.)

POLLUTION SOURCES

Until recently, there were no authoritative nationwide estimates to quantify the many kinds of physical, chemical, and organic wastes that enter the nation's waters. However, rough approximations have now become available.

The National Residuals Discharge Inventory, completed in 1975 by the National Academy of Sciences, estimates the wastes entering U.S. waterways, with assessments of the quantities generated and discharged in each of the 3,111 counties of the continental United States.[65] The inventory considers four traditional wastewater variables: biochemical oxygen demand (BOD), total suspended solids (TSS), nitrogen (N), and phosphorus (P). It includes estimates of point-source discharges and many nonpoint sources.

Municipal Wastewaters

According to the inventory's estimates, municipal sources were responsible for the discharge of 5.6 billion pounds of BOD and 5.9 billion pounds of TSS into U.S. waterways in 1973, as shown in Figure II-37. If all municipal wastewater sources in the United States had secondary treatment, it is estimated that the amounts discharged would be reduced to 2.6 billion pounds of BOD and 3.0 billion pounds of TSS, a reduction of about 50 percent in each case.

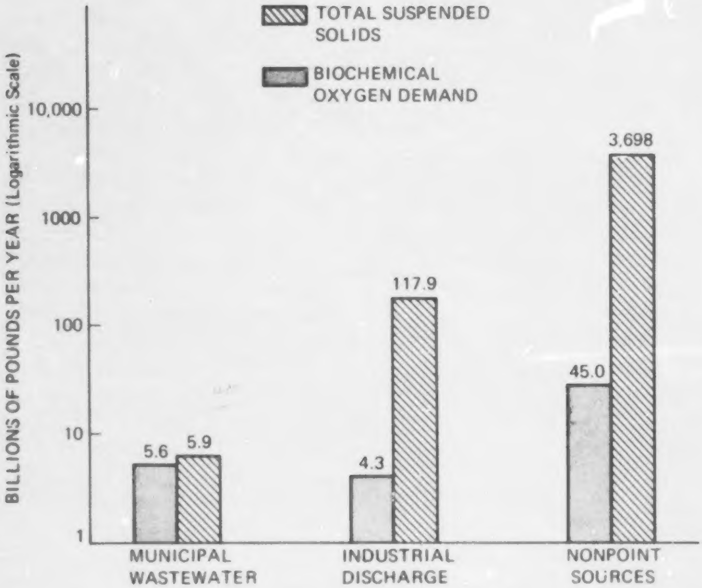


FIGURE II-37. **Estimated nationwide water pollution loadings of suspended solids and oxygen demanding material. Estimates refer to calendar year 1973. Loadings from municipal and industrial sources tend to produce acute local water quality problems, more than loadings from nonpoint sources which are more diffuse (Source: National Residuals Discharge Inventory)** [44]

Municipal wastewaters—that is, those treated by and discharged from publicly owned treatment works—include wastes from households; commercial establishments such as garages, laundries, and restaurants; certain industrial wastewaters; and the ground water and runoff from precipitation that enters the municipal sewer system. Traditionally, municipal treatment works have been designed first to remove suspended solids (mostly organic wastes) and second to reduce oxygen demand. In primary sewage treatment, suspended solids are allowed to settle. About 60 percent of the suspended solids is normally removed in this process, which also removes about 30 percent of the BOD. Secondary treatment is a microbiological digestion process. This process enhances the BOD reduction to 85 percent or more, and the solids removal to 90 percent or more. Both primary and secondary treatment reduce the BOD in wastewater before discharge by removing organic matter. Most of this organic matter is converted into microbial sludge, which then becomes a solid waste disposal problem (see Chapter I).

In reducing TSS and BOD, municipal treatment plants incidentally change many other components of the wastewater. Fats, oils, and grease are reduced a certain amount, but not by as much as TSS or BOD. Most of the fats, oils, and grease removed from the effluent accumulate in the sludge; very little is oxidized biologically. Some heavy metals are also removed by precipitation and incorporated into the sludge. Other naturally occurring toxic chemicals such as cyanides and some phenolic compounds can be oxidized by microorganisms when they are diluted to low concentrations in municipal wastewaters.

Municipal wastewaters also contain the infectious agents of waterborne disease. Traditional primary and secondary treatment can reduce the disease-producing organisms considerably, but without further treatment, the effluent may still contain enough pathogenic microorganisms to be a potential health hazard. For this reason, many treatment facilities also practice disinfection, usually by chlorination. Although fecal coliform bacteria are not themselves important human pathogens, they are commonly used as an indicator of the possible presence of pathogenic microorganisms. Effluent disinfection is therefore often evaluated by the reduction in numbers of fecal coliforms.

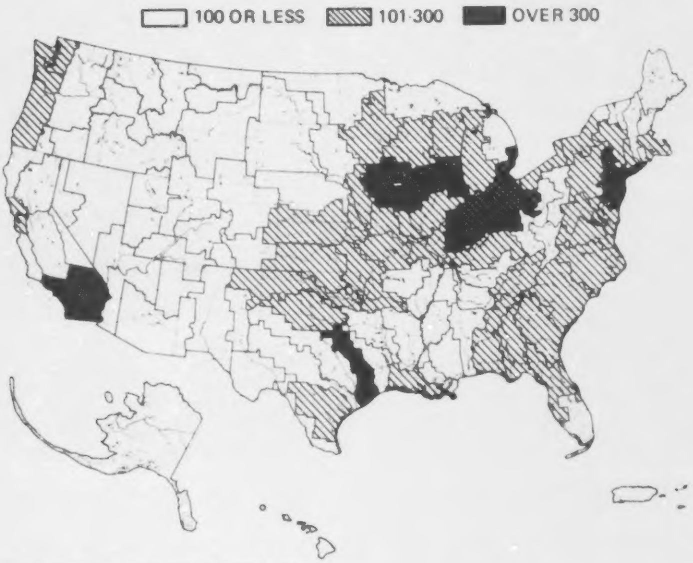
All of the substances mentioned—fats, oils, grease, heavy metals, toxic organic material, and fecal microorganisms—significantly affect water quality. Thus, evaluation of municipal wastewater discharges in terms of BOD, TSS, N, and P alone present only a part of the picture. Fortunately, since decreases in these four variables are almost always accompanied by reductions in the others, BOD, TSS, N, and P can serve to some extent as indicators of overall improvements in wastewater treatment.

The nation has undertaken a large spending program under Public Law 92-500 to abate pollution from municipal wastes. Figures II-38 through II-40 show the financial dimensions of this program by geographical areas.[86] Figure II-38 shows the cost of replacing the wastewater treatment facilities already in operation in July 1974, according to EPA's 1974 "needs" survey. It is not surprising that these facilities are concentrated around some of our major population and industrial centers.

Figure II-39 shows the distribution of funds under EPA's Construction Grant Program, pursuant to Public Law 92-500, for all construction grants awarded by May 1976, including treatment facilities, sewers, and outfalls. Areas with the greatest investment in existing facilities tend to be among those receiving the most money under the grants program.

Figure II-40 shows the treatment facilities needed for the future, as identified in EPA's 1974 "needs" survey. The areas of highest need are more extensive than the areas, shown in Figures II-38 and II-39, that already have received substantial investments. They encompass the entire north-central and southeastern United States as well as isolated western areas. The high degree of need in the Southeast reflects the fact that there are relatively few facilities in place (Figure II-38), and substantial population growth is anticipated.

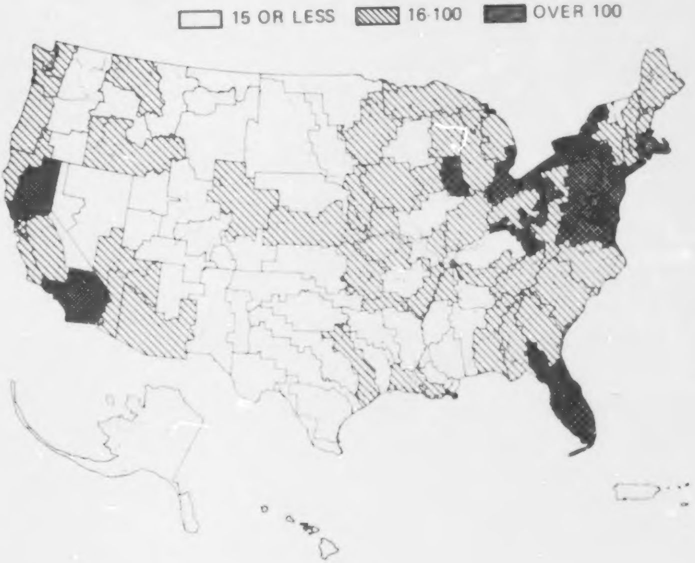
A comparison of the three figures with U.S. population density shows, not unexpectedly, that investment in municipal treatment



100 OR LESS
101-300
OVER 300

Alaska, Hawaii, and Puerto Rico not drawn to scale

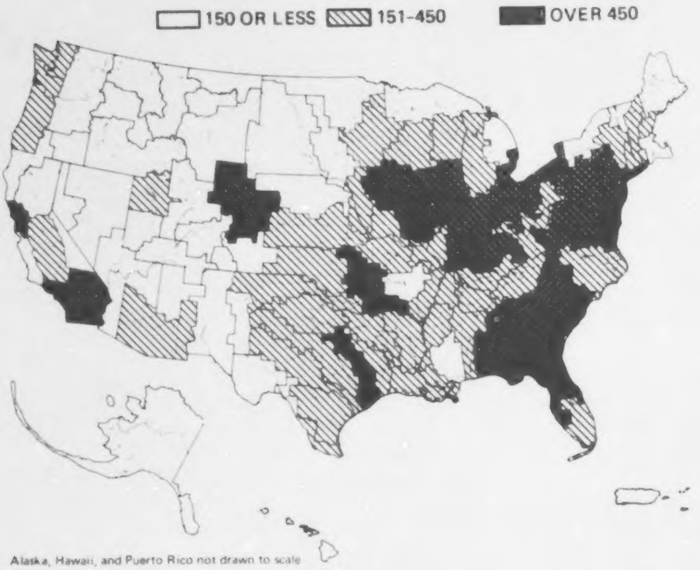
FIGURE II-38. Replacement values (in millions of dollars) of existing municipal sewage treatment facilities (Source: CEQ analysis of EPA data)[65,66]



15 OR LESS
16-100
OVER 100

Alaska, Hawaii, and Puerto Rico not drawn to scale

FIGURE II-39. Values (in millions of dollars) of municipal sewage treatment facilities under construction or approved as of May 1976 (Source: CEQ analysis of EPA data)[65,66]



Alaska, Hawaii, and Puerto Rico not drawn to scale

FIGURE II-40. Values (in millions of dollars) of municipal sewage treatment facilities still needed. Map values include treatment plants, sewers, and outfalls (Source: CEQ analysis of EPA data) [65, 66]

facilities has been made around many of our population centers. Future expenditures probably will be concentrated in these same areas and in areas of rapid growth.

Industrial Discharges

According to the National Residuals Discharge Inventory, U.S. industrial sources in 1973 discharged 4.3 billion pounds of BOD and 117.9 billion pounds of TSS (Figure II-37). If the controls prescribed by the 1972 amendments to the Federal Water Pollution Control Act were achieved, these discharges would be reduced to an estimated 0.5 billion pounds of BOD and 11.8 billion pounds of TSS by 1977. For 1983, the estimates are 0.3 billion pounds of BOD and 4.2 billion pounds of TSS assuming the achievement of prescribed controls.

Because the character of industrial wastewaters and the pollution abatement requirements vary greatly from one industry to another, it is more difficult to generalize about industrial discharges than about municipal wastewaters. However, toxic materials, heavy metals, and organic compounds generally are more characteristic of certain (untreated) industrial wastewaters than of municipal wastewaters. Industrial wastewater can be either quite acidic (low pH), neutral, or alkaline (high pH), while municipal wastewaters are generally in the neutral range (pH 6.0 to 8.0), unless they include significant proportions of industrial wastes. Suspended solids in industrial wastewaters are usually quite different from those in municipal wastewaters, where they are largely organic, and their effects on receiving waters are associated with BOD and oxygen effects. The solids in industrial wastewaters are mostly attributable to mining operations, with effects similar to those of solids that are carried into streams by runoff from construction areas and eroded agricultural land.

Sedimentation and biological processes are used to treat some industrial wastewaters. Other wastes must be subjected to different treatment processes, including oxidation, reduction, neutralization, and precipitation. EPA has designated best practicable treatment levels for various industrial wastes, representing the best current state-of-the-art of treatment technology, and best available treatment, representing adoption of some treatment technologies that are presently in the experimental or development stage.

Nonpoint Sources

Immense quantities of pollutants enter U.S. waters without ever flowing through sewers, treatment facilities, or outfall structures. These wastes come from such nonpoint sources as land surface runoff, ground water, and the atmosphere, through precipitation and dry fallout.

The National Residuals Discharge Inventory estimated that the BOD and TSS entering U.S. waterways from nonpoint sources in 1973 totaled 45.0 billion pounds and 3,698 billion pounds, respectively (Figure II-37), exclusive of atmospheric or ground water sources. If urban runoff were controlled by providing storm water collection, storage, and treatment at the municipal treatment works, it is estimated that the annual contributions from runoff would be reduced to 22.9 billion pounds of BOD and 1,866 billion pounds of TSS. However, control of urban stormwater and runoff is expensive. The nationwide cost has been estimated by EPA at $305 billion.[67] Most agricultural runoff is even more difficult to deal with effectively.

RIVERS AND STREAMS

Nationwide Stream Quality Patterns

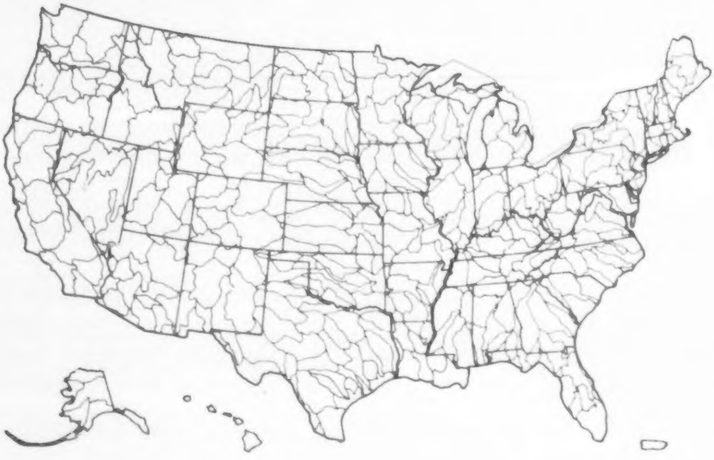
Water quality monitoring in the United States reached a milestone in 1975.[68] For the first time, uniform monitoring stations representing all of the nation's 334 subregional water quality accounting units were in operation. With the development of the U.S. Geological Survey's National Stream Quality Accounting Network (NASQAN), we now have a uniform capability to observe gross geographic patterns of water quality for the entire United States.[69] Each of the NASQAN monitoring stations measures the same water quality variables, with the same frequency, using the same methods. Each station is located at the downstream end of the subregional drainage area. Taken together, the 334 subregions encompass the entire land surface of the nation (Figure II-41).[70]

Despite this important achievement, caution must be used in applying NASQAN data to obtain geographic patterns of water quality. In a typical subregional accounting unit, the water quality of many tributary streams is represented by only one downstream NASQAN sampling point. If some of the upstream tributaries are polluted but others are not, the NASQAN values for that subregion depend very much upon the relative rates of flow in the tributaries and the distance of the sampling point from the upstream sources of pollution. NASQAN provides exactly what its name implies—a type of national *accounting* system that uniformly summarizes or averages the pollutant concentrations at designated reference points. The network does not identify every polluted stream segment, nor does it identify every unpolluted tributary in a stressed watershed.

Yet, a major benefit of NASQAN's uniform accounting concept is the network's capability to represent gross regional patterns. Water quality conditions, and human impact on them, must be viewed against the background of natural regional differences. These differences are caused mainly by the bedrock geological features which differ from region to region, by the amount of precipitation and other climate-related characteristics of an area, by the types of soils due to climate and bedrock interaction, and by the broad regional patterns of land use. Many aspects of water quality are determined by natural factors, as exemplified in the erodible areas of the Sierra Nevada, Cascade, and Rocky Mountains; the semi-arid and desert regions of the Southwest and Great Plains; or the leached nutrient-deficient soils of the rainy East, South, and Northwest.

Figures II-42 and II-43 provide examples of such regional differences. Figures II-43 shows the national patterns in average levels of dissolved solids, as measured during 1975 by NASQAN.[71] Dissolved solids, measured after all suspended matter is removed and all water is evaporated, represents the sum of the water's salts, metals, nonvolatile organic compounds, and all other dissolved substances.

The patterns in Figure II-42 show the strong influence of erosion and interactions of water and soil in the arid and agricultural regions of the Southwest, the Great Plains, and the western mountains. In these areas, precipitation is often sparse, dilution rates are low, and dissolved solids are high. Return flows from agricultural irrigation also contribute to these high levels of dissolved solids. The Northwest and the East have higher rates of precipitation, and the East in general is more mature geologically and less prone to erosion. Such factors contribute to the lower dissolved solids values there. In the north-central region, parts of Wisconsin and Minnesota also have low erosion factors and high rainfall. Moderately high dissolved solids in parts of Florida are attributable to limestone rocks and some mixing with saline waters.



Alaska, Hawaii, and Puerto Rico not drawn to scale

FIGURE II-41. Subregions (accounting units) of the National Stream Quality Accounting Network (Source: U.S. Department of the Interior, Geological Survey)

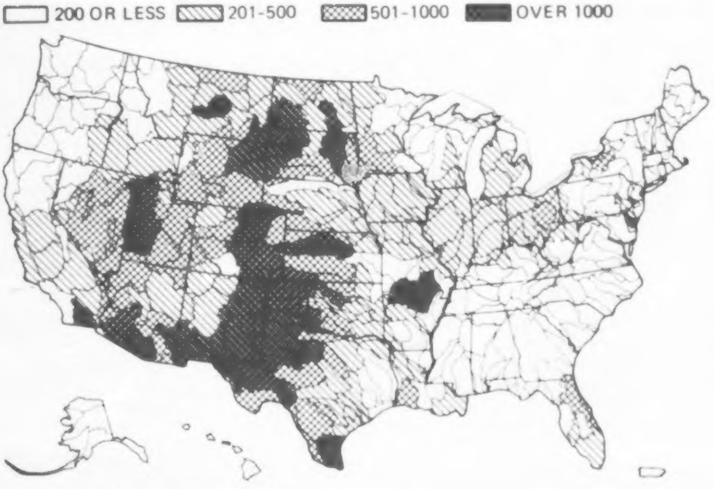


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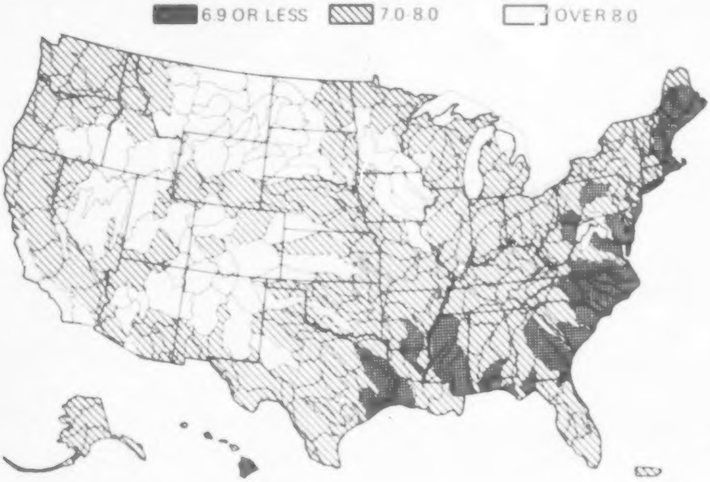
FIGURE II-42. Levels of dissolved solids in U.S. streams: 1975. Annual mean values are in milligrams per liter (Source: CEQ analysis of data from the U.S. Geological Survey's National Stream Quality Accounting Network)

Figure II-43 is a map of pH values, which represent the acidity or alkalinity of the water. Most of the nation's waters range from a pH of 7.0 (neutral) to 8.0 (slightly alkaline). In many parts of the western mountain states, deserts, and Great Plains, the water is mineral rich, containing salts that "buffer" it. Many of these waters are alkaline, with a pH greater than 8.0. In the East and Southeast, on the other hand, the waters tend to be low in minerals and buffering capacity. In many of these areas, the waters are slightly acidic, with a pH value of 6.9 or less. Factors that promote acidity may include the ecological dynamics of swamps (as seen in the Southeast), the effects of acid mine drainage (as seen in parts of Pennsylvania and West Virginia), and, possibly, acidic rainfall in the Northeast, as discussed in the Air Quality section of this chapter.

To measure the sanitary aspects of water quality, one of the best-known indicators is fecal coliform bacteria. These intestinal microorganisms are found in human and animal wastes. As stated previously, although usually not themselves harmful to health, these bacteria are commonly used as indicators of the presence of such wastes and of the possible presence of the more dangerous pathogens that such wastes may contain.

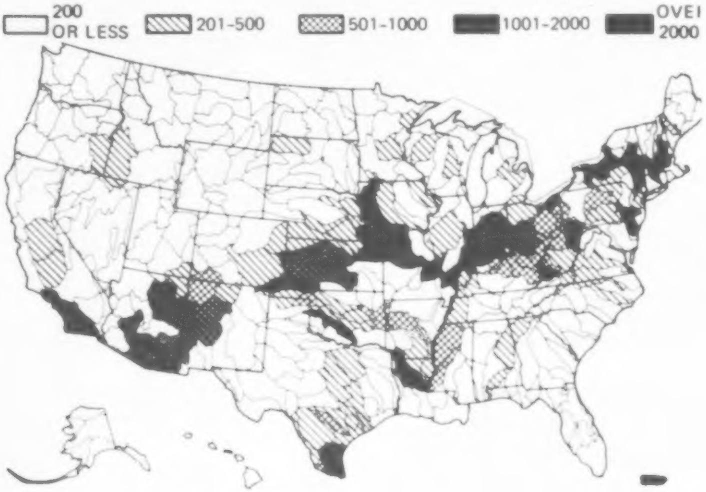


Alaska, Hawaii, and Puerto Rico not drawn to scale

FIGURE II-43. pH values of U.S. streams: 1975. Annual mean values are in standard pH units. (Source: CEQ analysis of data from the U.S. Geological Survey's National Stream Quality Accounting Network)

Figure II-44 shows the 1975 national patterns in fecal coliform levels.[72] All of the shaded areas on this map, both light and dark, represent violations of the water quality criterion for contact recreation, which is established to protect the health of swimmers.[73] The darker regions represent the worst violations.

Many of the heavily populated watersheds of the Midwest and Northeast have high coliform levels. Parts of the Midwest, Great Plains, and Southwest also show high coliform counts, often caused by livestock wastes and low summer streamflow. Some population centers in southern California and other western cities also show their impacts in high coliform levels. The low levels in the rainy Southeast reflect generally low population density, high streamflow rates, and the fact that many of the coastal population centers discharge their municipal wastes into saline waters, which are not monitored by NASQAN.



Alaska, Hawaii, and Puerto Rico not drawn to scale

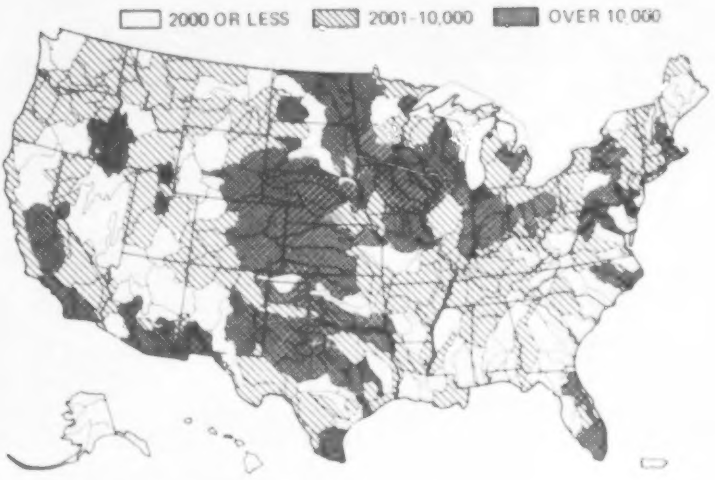
FIGURE II-44. Levels of fecal coliform bacteria in U.S. streams: 1975. Annual geometric mean values are in number of bacterial colonies per 100 milliliters. EPA's *Quality Criteria for Water* (draft, October 1975) designates a maximum level of 200 for protection of body contact recreation (swimming). The National Academy of Sciences' *Water Quality Criteria* (1972) designates a maximum level of 2,000 for protection of public water supplies (Source: CEQ analysis of data from the U.S. Geological Survey's National Stream Quality Accounting Network)

Average levels of algae in the nation's streams are shown in Figure II-45. Some population orientation, climate, and geological factors are evident on this map, as are the rough but striking correlations of high algae counts (over 10,000) with major agricultural areas of the country. Similar patterns are also reflected in the national distribution of total phosphorus (Figure II-46) and nitrogen (Figure II-47) levels, which is not surprising since these nutrients encourage algae growth. The geographical distribution of both algae and nutrients partly reflects the fact that nutrients from farm fertilizers, decaying organic material, and other sources are washed from the land into streams. On the other hand, some areas show high levels of nutrients but low algae counts, and vice versa. As the NASQAN data represent measurements for only 1 year, mapped as a rough level of geographic resolution, the full implications of these patterns will require continuing analysis.

The phosphorus map (Figure II-46) shows a slightly greater orientation toward population centers than does the nitrogen map (Figure II-47). Phosphorus levels are also elevated in some phosphate mining areas such as the Peace River watershed in Florida. The nitrogen map appears to reflect nitrate mining areas in Texas and Utah. The picture is not uniform, however, because several major mining areas do not show high values on this map.

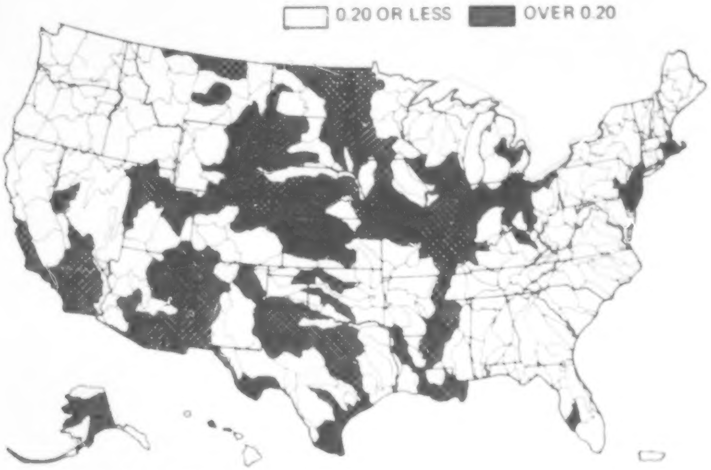
Geology is the main factor determining the levels of most trace metals in waters of the United States. Characteristically, as indicated by Figure II-48, the mountains, mineral belt, and deserts of the western states show the highest stream values for metals such as arsenic, cadmium, lead, and zinc. These maps also show evidence of some mining operations, but not all of the areas surrounding industrial and mining locations show high values of trace metals.

Mercury, one of the most important toxic metals, exhibits a national distribution pattern that reflects human activities more than these other metals. The geographic distribution of mercury levels in U.S. streams cannot presently be mapped in the same way as the other metals because some anomalies in NASQAN's 1975 analytical methods prevent the uniform interpretation of the network's mercury data. However, there are many sources of mercury contamination that warrant close scrutiny of its distribution patterns in soils and surface waters.[74] Aside from its natural distribution, mercury contamination arises directly from municipal waste disposal, agricultural activities, chlor-alkali, petrochemical, steel, and other industrial sources, mining and smelting operations, and many other sources. In addition, mercury is a volatile metal that becomes released to the atmosphere in significant quantities during the combustion of fossil fuels and the heating of many other mercury-containing chemicals. This atmospheric mercury, in particulate and gaseous forms, becomes



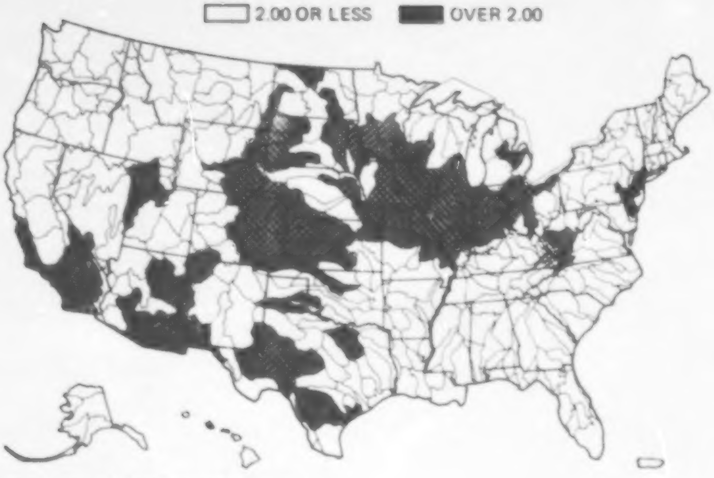
Alaska, Hawaii, and Puerto Rico not drawn to scale

FIGURE II-45. Levels of algae in U.S. streams: 1975. Annual mean values (total algae) are in cells per milliliter (Source: CEQ analysis of data from the U.S. Geological Survey's National Stream Quality Accounting Network)



Alaska, Hawaii, and Puerto Rico not drawn to scale

FIGURE II-46. Levels of total phosphorus in U.S. streams: 1975. Annual mean values (total phosphorus as P) are in milligrams per liter. EPA's *Quality Criteria for Water* (draft, October 1975) associates a level of 0.10 or higher with possible nuisance algae growths (Source: CEQ analysis of data from the U.S. Geological Survey's National Stream Quality Accounting Network)



Alaska, Hawaii, and Puerto Rico not drawn to scale

FIGURE II-47. Levels of total nitrogen in U.S. streams: 1975. Annual mean values (total nitrogen as N) are in milligrams per liter (Source: CEQ analysis of data from the U.S. Geological Survey's National Stream Quality Accounting Network)

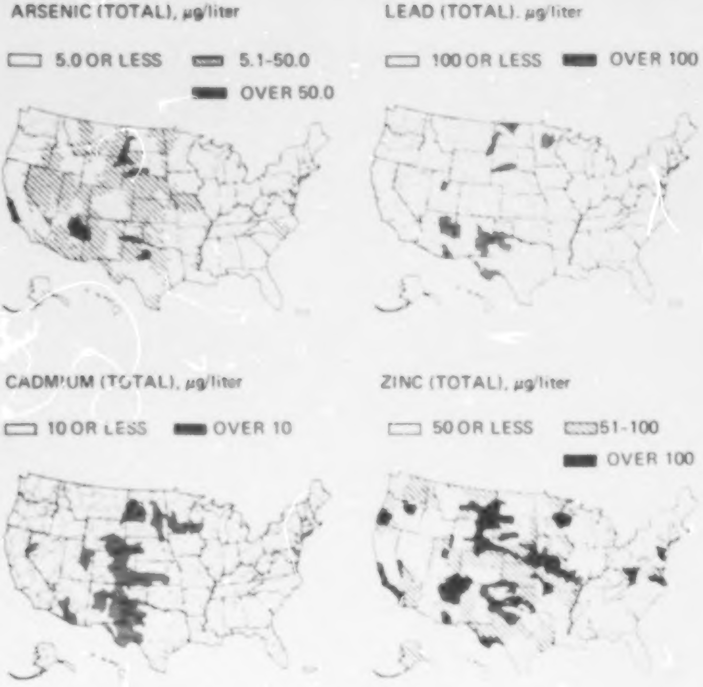
dispersed by winds and deposited on the land through precipitation and dry fallout.

CEQ is conducting a study of the distribution and likely causes of mercury levels in U.S. streams. The findings of this study will be available in the near future.

Trends on Major Rivers

Two years ago, in our Fifth Annual Report,[75] we described the findings of the first National Water Quality Inventory,[76] conducted by EPA in response to Section 305(a) of the 1972 amendments to the Federal Water Pollution Control Act. In that 1974 inventory, historic data from 22 of the nation's major waterways were analyzed to determine what general water quality changes had occurred from 1963 to 1972. The most significant conclusions of the inventory were that overall improvements could be seen in the lowered levels of coliform bacteria and oxygen-demanding organic wastes, but worsening trends were apparent in the rising levels of nutrients and eutrophication variables.

This year, CEQ has examined and updated some of the information presented in the 1974 inventory, and will do so periodically on a consistent, selective basis. Such continuing examination can help to evaluate the progress of nationwide water pollution abatement


ARSENIC (TOTAL), µg/liter
5.0 OR LESS
5.1-50.0
OVER 50.0
LEAD (TOTAL), µg/liter
100 OR LESS
OVER 100
CADMIUM (TOTAL), µg/liter
10 OR LESS
OVER 10
ZINC (TOTAL), µg/liter
50 OR LESS
51-100
OVER 100

Alaska, Hawaii, and Puerto Rico not drawn to scale

FIGURE II-48. Total levels of four metals in U.S. streams: 1975. Annual mean values (total metals) are in micrograms per liter. The National Academy of Sciences' *Water Quality Criteria* (1972) designates the following levels for protection of public water supplies: arsenic, 100; cadmium, 10; lead, 50; zinc, 5,000 (Source: CEQ analysis of data from the U.S. Geological Survey's National Stream Quality Accounting Network)

efforts and judge some persistent problems and water quality impacts that are not yet being controlled.

In our first examination, we focus on 12 of the 18 major rivers that were evaluated in the 1974 inventory (Figure II-49). These 12 include four western rivers: the Wilamette, Colorado, Rio Grande, and Red; four rivers from the Midwest and Great Plains: the Mississippi, Missouri, Ohio, and Tennessee; and four eastern rivers: the Hudson, Delaware, Susquehanna, and Potomac.

For this evaluation, 425 monitoring stations were selected on the mainstems of the 12 rivers. These stations were chosen from STORET, EPA's computerized water quailty data system, on the bases of sampling location, monitoring methods, period of record, sampling frequency, and other criteria.[78] Most of the selected stations

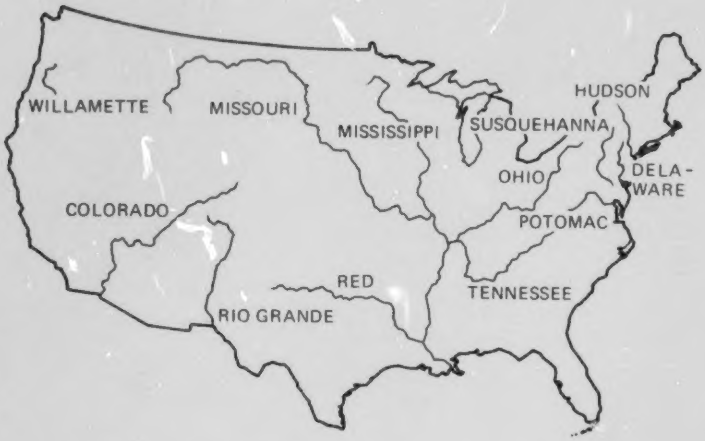

WILLAMETTE
MISSOURI
MISSISSIPPI
SUSQUEHANNA
HUDSON
OHIO
DELA-WARE
COLORADO
POTOMAC
RED
TENNESSEE
RIO GRANDE

FIGURE II-49. **Twelve major rivers in CEQ's trend analysis**

are operated by the U.S. Geological Survey, but data were also included from several other federal and state agencies. In general, the data base chosen for this evaluation includes the best ambient trend monitoring stations on the 12 rivers under consideration.

Of the several kinds of statistical analyses and indicators used in the CEQ evaluation,[77] the most informative trend indicator seems

This irrigation canal in California receives runoff containing nitrogen and phosphorus from fertilizers used on adjacent farmlands. Water quality maps of nitrogen and phosphorus show that U.S. streams in agricultural areas often have high levels of these elements (Photo credit: U.S. Environmental Protection Agency—Documerica, Charles O'Rear) to be the *composite violation rate*. This indicator represents the proportion of all measurements of a specific water quality variable which exceeds the "benchmark" value for that variable. Benchmark values were determined on the basis of published water quality criteria, standards, or in some cases arbitrarily chosen reference points (Table II-11). Thus, the word "violation" in this indicator is used for simplicity and does not necessarily imply a legal significance.

The composite violation rate has several important advantages as an indicator. First, it relates the water quality data to known reference levels, many of which are associated with potential impacts such as beach closings or harm to aquatic life. Second, the composite indicator statistically reduces the bias caused by any high values erroneously recorded, a problem with most large data bases, in contrast to certain other measures such as mean values. Third, the composite violation rate can be applied flexibly. It can be used for a single monitoring station, all the stations on a river or river reach, or even the entire nation.

As with most other indicators and statistical measures, some of the year-to-year variation in composite violation rates may not represent significant changes in water quality. Instead, the variation may be due to changes in streamflow, temperature, measurement schedules, and other factors. A genuinely significant improvement or worsening in a particular water quality variable usually becomes apparent only after several years of consistently different values have been measured in a river.

Fecal coliform bacteria was the main variable chosen to illustrate trends in sanitary water quality. Annual composite violation rates for 1968 to 1975 are shown in Figure II-50 for the 12 major rivers. The high rate of violations is evident in the figure. Since 1968, most of the measurements made at the 425 reference trend monitoring stations on these rivers have exceeded the water quality criterion for contact recreation, which is set to protect the health of swimmers.

Figure II-50 shows the same indicator for only the highest- and

TABLE II-11. Benchmark values used in CEQ's water quality trend analysis

Variable	Value	Reason
Fecal coliform bacteria	200 cells per 100 milliliters	Health protection (swimming)
Biochemical oxygen demand	5 milligrams per liter	[a]
Dissolved oxygen	4 milligrams per liter	Aquatic life protection
Total phosphorus	0.1 milligrams per liter	Prevention of nuisance algae growth
Total nitrogen	1.0 milligrams per liter	[a]

[a] Arbitrary reference point selected by CEQ researchers.

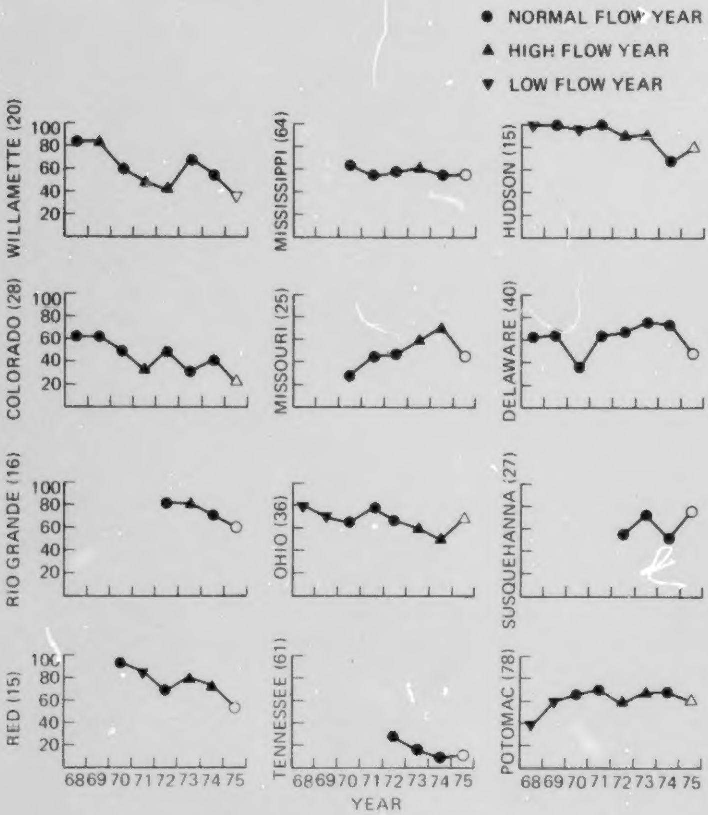


FIGURE II-50. Annual composite "violation" rates for fecal coliform bacteria on 12 major rivers: 1968-1975. Composite violation rates are the percentage of observations that exceeded the water quality criterion for human contact recreation (200 organisms per 100 milliliters) at all reference trend stations combined. Number of stations shown in parentheses. All 1975 data (open symbols) are preliminary (Source: CEQ analysis of selected data from EPA's STORET system)[78]

lowest-flow 3-month periods in each year. In most cases, these periods were March through May (high flow season) and August through October (low-flow season). With some exceptions, the records for low-flow seasons tend to illustrate trends related to point sources, while the high-flow seasons tend to show the effects of surface runoff and combined sewer overflows.

Considered together, Figures II-50 and II-51 indicate significant overall improvements in fecal coliform violation rates for at least five of the 12 rivers: the Willamette, Colorado, Red, Ohio, and Tennessee. Trends are mixed or uncertain on the other rivers, although it is

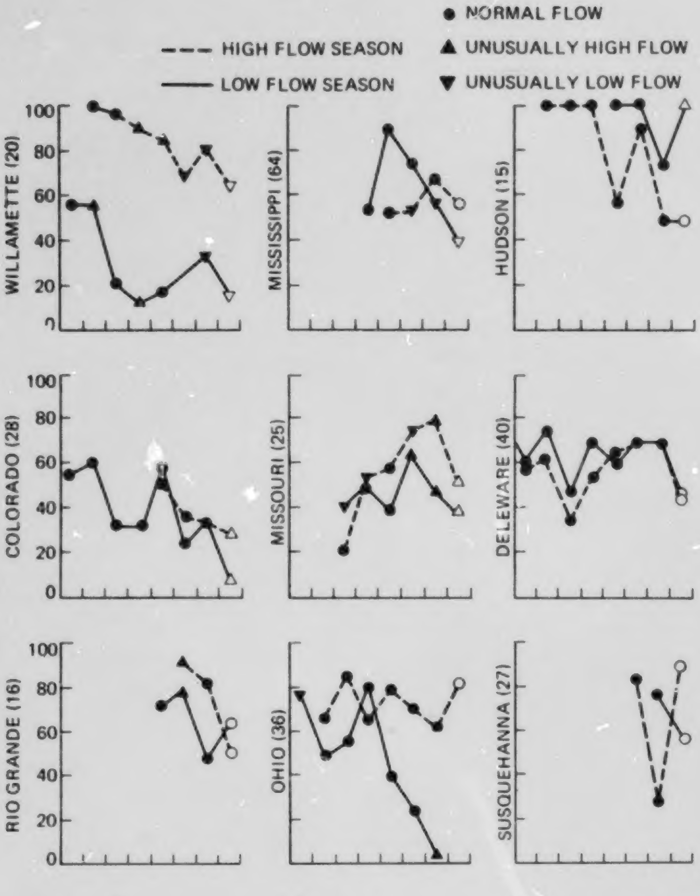


FIGURE II-51. High- and low-flow seasonal composite "violation" rates for fecal coliform bacteria on 12 major rivers: 1968-1975. Composite violation rates are the percentage of observations that exceeded the water quality criterion for human contact recreation (200 organisms per 100 milliliters) at all reference trend stations combined. Number of stations shown in parentheses. All 1975 data (open symbols) are preliminary (Source: CEQ analysis of selected data from EPA's STORET system)[76]

significant that none of these other rivers shows a definite worsening trend in fecal coliforms.

The four western rivers share similar problems, such as wastes from feedlots, irrigation return flows, and combined municipal sewer overflows. Water quality in the Willamette River had dramatically improved during the previous decade,[79] and its remaining sanitary problems are mostly related to runoff and sewer overflows during high flow periods (see Figure II-50). High fecal coliform levels in the Colorado are mostly associated with feedlot contamination,[80] but there seem to be improvements (Figures II-50 and II-51).

In the Great Plains and Midwest, overall improvements can be seen for the Ohio and Tennessee Rivers, but not for the Mississippi or Missouri (Figures II-50 and II-51). Almost all of the Missouri's fecal coliform violations are in the lower part of the river, as indicated in Figure II-52.

Sanitary water quality in the Ohio and Tennessee Rivers has improved mostly because of advances in municipal sewage treatment over the past several years.[76] New and upgraded facilities at Chattanooga and several cities in the Ohio basin have effected consistently lower violation rates for fecal coliforms (Figures II-50 and II-51). Improvements on the Ohio River have been dramatic during low-flow periods (Figure II-51). BOD violation rates on both rivers have also declined in recent years and are negligible today.

No distinct improvement in bacterial violations are seen in the data for any of the four eastern rivers (Figures II-50 and II-51), although there have been definite reductions in BOD violation rates on the Delaware and Potomac Rivers (Figure II-53) and for dissolved oxygen levels on the Delaware (Figure II-54).

Sanitary water quality on the Delaware, Hudson, and Potomac Rivers depends for the most part on municipal and industrial point sources. The Susquehanna River has a low municipal load, but has historically exhibited high coliform counts because of dairy and beef herds.[80]

Water quality on the Delaware River from Philadelphia to Wilmington is improving, but has been extremely poor in recent years. Over the past decade, the Delaware is the only major river in this evaluation that has exhibited significant violation rates for dissolved oxygen.[81] At least one-third of the organic load on the Delaware has come from industrial sources.[80] The worst violations for BOD and dissolved oxygen have occurred during the low-flow summer season, as indicated in Figures II-53 and II-54. As the point sources are controlled further, however, this seasonal distinction becomes less pronounced.

The Potomac River has exhibited a fairly constant overall violation rate for fecal coliforms since 1969—between 60 and 70 percent (Figure II-50). Violation rates for fecal coliforms have tended to be higher and more variable during the high-flow season (Figure II-51). BOD violations consistently have been highest during the low-flow

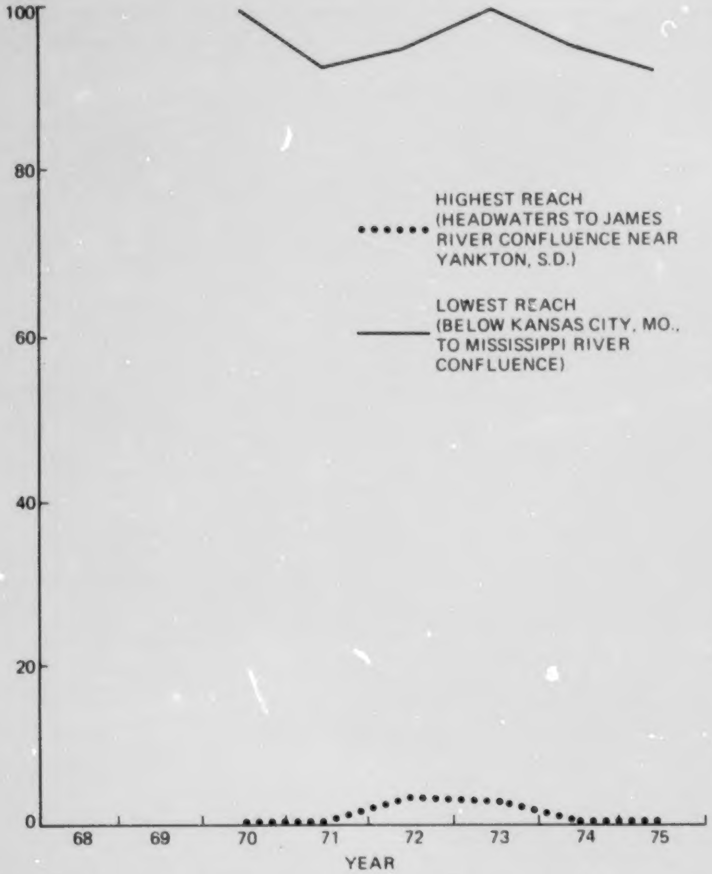


FIGURE II-52. Annual composite "violation" rates for fecal coliform bacteria in the Upper and Lower Missouri River: 1970-1975. Composite violation rates are the percentage of observations that exceeded the water quality criterion for human contact recreation (200 organisms per 100 milliliters) at all reference trend stations combined (Source: CEQ analysis of selected data from EPA's STORET system) [78]

season (Figure II-53), apparently due to a combination of dilution and temperature effects, combined with overloaded municipal treatment facilities during high-flow periods.

LAKE EUTROPHICATION

The National Eutrophication Survey has completed almost all of its planned sampling and analyses during the past year. Of 201 selected lakes and reservoirs studied in the northeastern and north-central United States, 81 percent is in an advanced state of eutro-

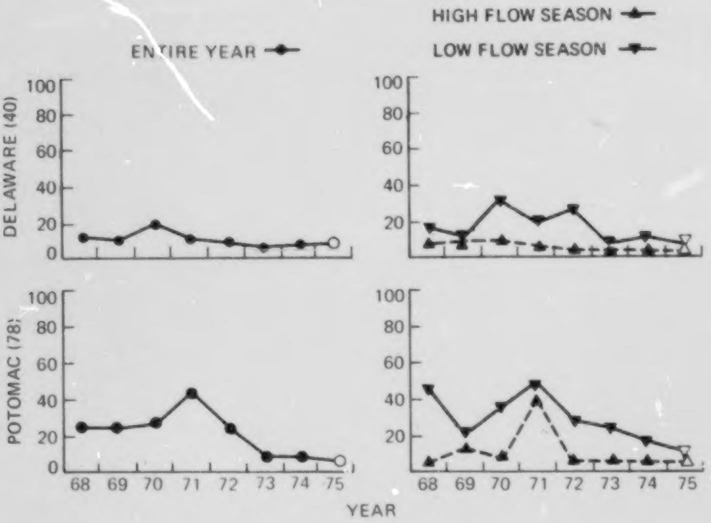


FIGURE II-53. Composite "violation" rates for biochemical oxygen demand in Delaware and Potomac Rivers: 1968-1975. Composite violation rates are the percentage of observations that exceeded the arbitrarily selected benchmark level of 5.0 milligrams per liter at all reference trend stations combined. Number of stations shown in parentheses. All 1975 data (open symbols) are preliminary. (Source: CEQ analysis of selected data from EPA's STORET system)[78]

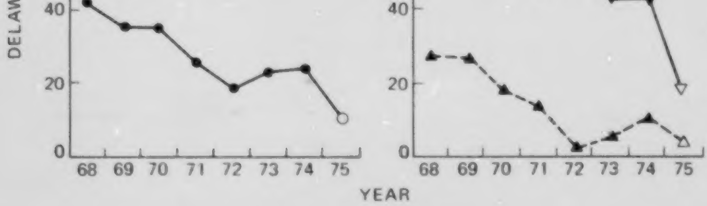


FIGURE II-54. Composite "violation" rates for dissolved oxygen in Delaware River: 1968-1975. Composite violation rates are the percentage of observations that were below the water quality criterion for aquatic life protection (4.0 milligrams per liter) at all reference trend stations combined. 1975 data (open symbols) are preliminary. (Source: CEQ analysis of selected data from EPA's STORET system)[78]

phication, or nutrient enrichment, as it is sometimes called.[82] Water bodies impacted by municipal sewage discharges were studied in ten states: Connecticut, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New York, Rhode Island, Vermont, and Wisconsin. Only 6 percent of the lakes was judged to be in the most pristine (oligotrophic) category. The majority, 75 percent, was classified as eutrophic, and 6 percent of the lakes was found to be exceptionally enriched (hypereutrophic). These classifications are based on biological criteria and reflect a continuum of nutrient enrichment levels ranging from oligotrophic upward to hypereutrophic. The terms, borrowed from scientific literature, describe the evolution of standing water bodies.

Nutrient enrichment, or the relative state of eutrophication, is most often determined by nitrates and phosphates that enter the water body from agricultural and urban runoff and from sewage treatment plants and industrial discharges.

Field data used in the survey were obtained between 1972 and 1975 by EPA and other cooperating federal and state agencies. This survey began by investigating the threat of accelerated eutrophication caused by sewage in freshwater lakes and reservoirs in the Northeast. As the program evolved, the scope was broadened to include lakes not impacted by sewage. Water bodies west of the Mississippi River were selected on a random basis. Other factors that may be involved in eutrophication also were measured: turbidity, color, temperature, trace elements, and vitamins. The program ultimately involved studies of 815 lakes and reservoirs, 4,200 tributaries and lake outlets, and 1,000 sewage treatment plants. Results from more than 600 additional lakes ultimately will be added to the compendium.

Thus far, findings clearly indicate tendencies toward high nutrients and productivity in the majority of the U.S. lakes and reservoirs studied. Most of these standing waters suffer from nutrient introduction beyond their capabilities for assimilation. In cases where nutrient retention was estimated, 46 lakes or reservoirs retained more than 50 percent of the nitrogen or phosphate introduced, and 5 retained more than 90 percent; 52 indicated a net loss of either nitrogen or phosphorus at the outlet.

The survey found that 57 percent of all lakes sampled in 1972 were phosphorus-limited—that is, the availability of phosphorus is the main chemical factor determining algae growth.[83] These results generally support a total phosphorus guideline of 25 micrograms per liter to maintain conditions free of nuisance algae blooms. Although nitrogen is the growth-limiting nutrient in 37 percent of the lakes studied, nitrogen limitation does not generally occur until a lake system is already highly enriched.[84] Control of nitrogen as a limiting nutrient is not easy because nitrogen enters lakes in large quantities from sources such as land runoff, precipitation, and nitrogen fixation.

Phosphorus should be more easily controlled, but in fact national progress toward removing it from surface waters has been limited.

According to the survey, total phosphorus and nitrogen in municipal wastewaters after sewage treatment averaged 2.2 and 6.0 pounds per capita per year. The lowest phosphorus concentrations appeared in states banning phosphate detergents or with specific processes for phosphorus removal at treatment plants. These data, developed from effluent samples of 505 municipal treatment facilities serving more than 6.5 million persons in 27 states east of the Mississippi River indicate that with advanced treatment for removal, phosphorus concentrations were reduced to less than 50 percent of the average values observed in conventionally treated effluents.[85]

Major eutrophication impacts are also related to nonpoint nutrient sources. In a study of 143 subdrainage areas, urban runoff was found responsible for the entry of 158 pounds of phosphorus and 3,870 pounds of nitrogen per square mile into surface waters.[86] Agriculture was responsible for an even greater influx of phosphorus. Forest lands contributed far less.

Another study based on land use, geology, and precipitation has led to similar conclusions.[87] Average nutrient levels were found to be considerably higher in streams draining agricultural watersheds than those draining forested lands, but the major difference was in phosphorus. Figure II-55 shows the relationships. These studies indicate that control of point nutrient sources alone will not stem eutrophication in the nation's lakes and reservoirs.

OCEAN DUMPING

Despite the legislation passed to regulate direct disposal of large quantities of waste materials into the nation's estuarine and marine waters, the issue is still a serious environmental concern. The Marine Protection, Research, and Sanctuaries Act of 1972 [88] prohibits ocean disposal of radioactive wastes and agents of biological, chemical, and radiological warfare. An amendment to the act added other prohibited material, as specified in the 1972 International Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.

Regulation of ocean dumping of nonprohibited materials is divided between two federal agencies: EPA and the Army Corps of Engineers. EPA grants permits under appropriate conditions for all nondredged materials proposed for ocean dumping. The Army Corps of Engineers grants permits for all dredged materials, with EPA concurrence on site, materials, and quantities. Surveillance of all dumping is assigned to the U.S. Coast Guard, and violations of permits and illegal dumping are subject to civil and criminal penalties. From April 1973 to December 1974 there were 983 ocean disposal surveillance missions undertaken by the Coast Guard; 36 violations were referred to EPA.[89]

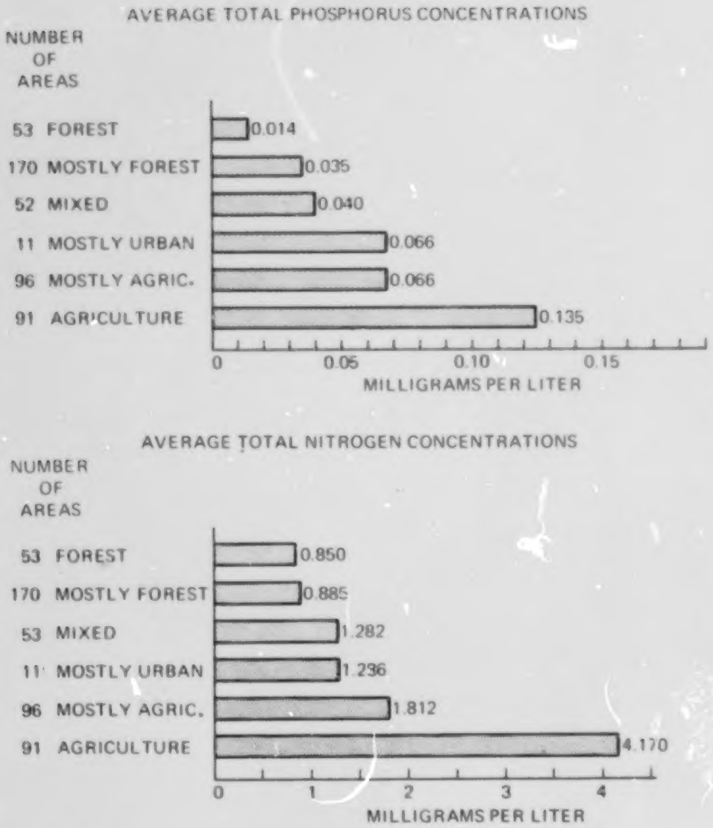


FIGURE II-55. Relationships between general land use and total phosphorus and total nitrogen concentrations in streams (Source: U.S. Environmental Protection Agency)

More than 130 million tons of waste materials was dumped at sites near the Atlantic, Gulf, and Pacific coasts in 1974 (Figure II-56).[90] Of this, an estimated 118 million tons, or more than 90 percent, consisted of material dredged and dumped either by the Army Corps of Engineers, or under a Corps permit. Dredged disposal increased more than 200 percent from 1973 to 1974 because of extensive silt removal following floods in the Mississippi River Basin. Locations of spoil disposal are shown in Table II-12. In 1975, an estimated 81 million tons of dredged material was dumped in marine waters by the Corps, according to preliminary figures.[91] Although disposal of dredge spoils is frequently ignored in the assessment of ocean dumping, aquatic sediments may contain heavy metals, chlorinated hydrocarbons, and other toxic materials at levels several times those found in the over-

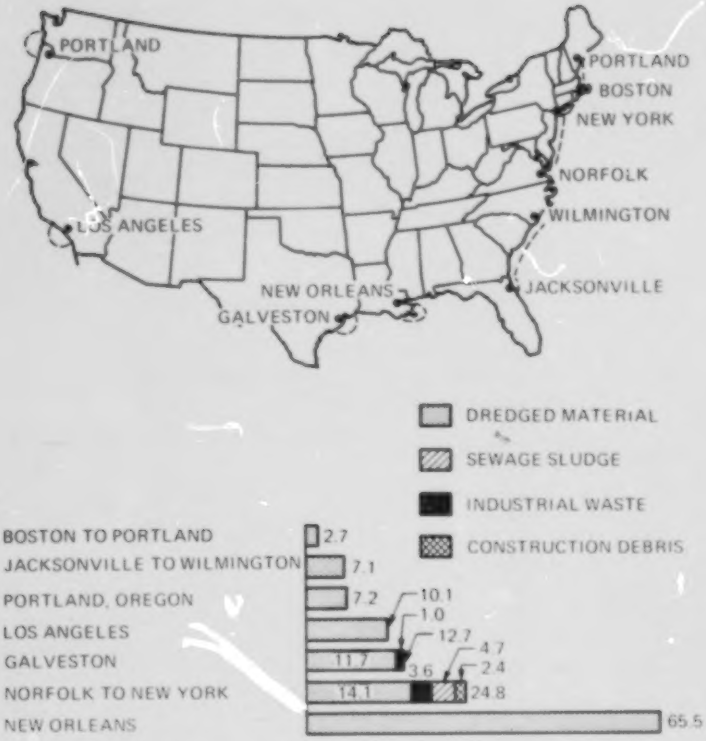


FIGURE II-56. Ocean waste disposal (in millions of tons) by category: 1974 (Source: U.S. Department of Commerce)

lying water column.[92] Ocean disposal resuspends these critical elements and places the surrounding marine ecosystem at risk.

More than 13.5 million tons of municipal and industrial wastes were dumped into the oceans at 11 principal sites on the Atlantic and Gulf coasts in 1974, with about 90 percent going into the New York Bight area (Figure II-57). Although dumping of industrial waste in the Gulf of Mexico decreased 33 percent, from something under 1.5 million in 1973 to 0.95 million tons in 1974, industrial dumping on the Atlantic coast increased 17 percent, from almost 4 million to more than 4.75 million tons in the same period (Table II-13). Industrial disposal along the Atlantic seaboard consists largely of acid wastes at a site in the New York Bight where dumping has taken place since 1948; concern about the environmental effects of this waste is centered on trace metals in solution.

Ocean dumping of the greatest concern in the New York Bight is the disposal of 5.6 million tons of sewage sludge from metropolitan New York and New Jersey.[93] Dumping by metropolitan Philadelphia

TABLE II-12. Ocean disposal of dredged material (Source: U.S. Army Corps of Engineers)*

Army Corps of Engineers Division	1973		1974			1975		
	Millions of cubic yards	Millions of tons	Millions of cubic yards	Millions of tons	Percent of change	Millions of cubic yards	Millions of tons	Percent of change
New England	2.064	1.909	2.262	2.093	+ 8	0.883	0.816	−60
North Atlantic	12.269	11.349	11.710	10.832	− 4	13.600	12.580	+13
South Atlantic	7.765	7.183	5.911	5.468	−23	11.715	10.837	+50
Lower Mississippi Valley	0	0	54.600	50.505	—	33.520	31.006	−38
South west	10.781	9.972	9.244	9.013	− 9	8.581	7.938	−12
South Pacific	3.726	3.447	8.455	7.821	+55	2.706	2.503	−68
North Pacific	7.586	7.017	5.982	5.534	−21	7.609	7.038	+21
Pacific	0.17	0.15	0	0	—	9.212	8.521	—
Total	44.208	40.892	98.164	91.266	−55	87.826	81.239	−10

* Data rounded for clarity.

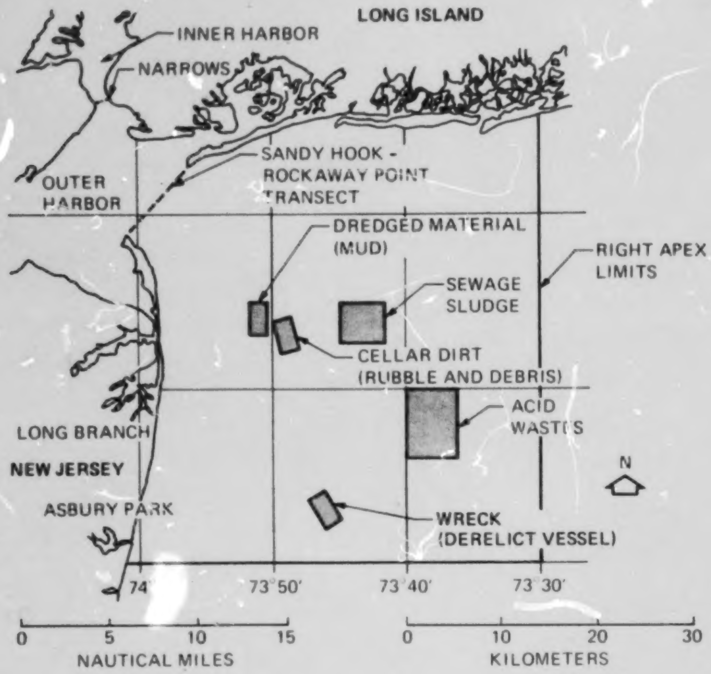

LONG ISLAND
INNER HARBOR
NARROWS
SANDY HOOK - ROCKAWAY POINT TRANSECT
OUTER HARBOR
DREDGED MATERIAL (MUD)
RIGHT APEX LIMITS
SEWAGE SLUDGE
CELLAR DIRT (RUBBLE AND DEBRIS)
ACID WASTES
LONG BRANCH
NEW JERSEY
N
ASBURY PARK
WRECK (DERELICT VESSEL)
74°
73°50′
73°40′
73°30′
0
5
10
15
NAUTICAL MILES
0
10
20
30
KILOMETERS

FIGURE II-57. New York Bight apex and existing dump sites (Source: U.S. Environmental Protection Agency)

at a site about 40 miles east of Ocean City, Maryland, creates a similar problem, as indicated in Figure II-58.

The dense portion of the dumped sludge sinks to the bottom at the dump site, and another part consists of dissolved and suspended solids and flotables that remain in the water column for varying times, depending upon composition of the sludge and circulation of the seawater. Sewage sludge is the end result of concentrating many forms of domestic and industrial wastes, and therefore may contain substantial quantities of heavy metals. Although a bactericidal quality is frequently ascribed to saline waters, there is reason to suspect that organisms pathogenic to humans may survive after dumping in coastal waters.[94]

As shown in Table II-13, ocean disposal of sewage sludge is on the increase because of population increase, an upgrading of national sewage treatment, and the lack of appropriate land sites in metropolitan New York City and Philadelphia. It is estimated that treatment plant output in the New York/New Jersey area will increase about 200 percent by 1981.

Solid wastes are also dumped in other coastal marine areas, especially off the Pacific coast, but this practice is slowly decreasing be-

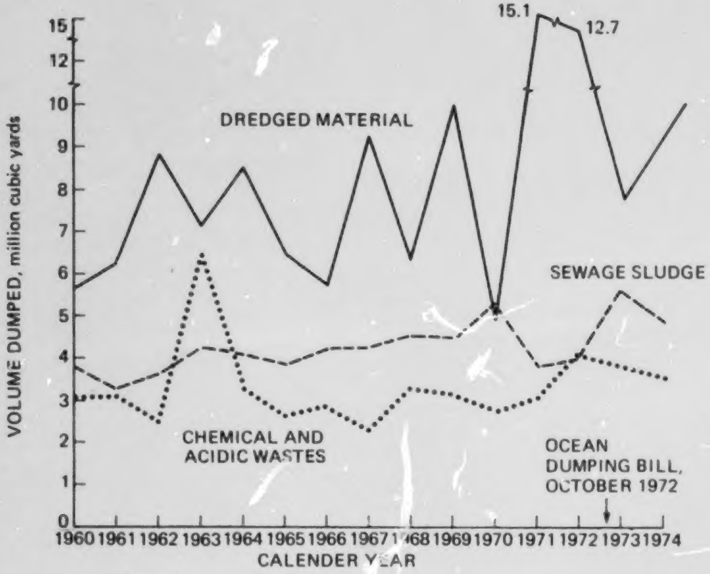


FIGURE II-58. Waste dumpings in and adjacent to the New York Bight (Source: U.S. Environmental Protection Agency)

cause of increased legal pressures to find alternative sites. Explosives were formerly dumped in deep ocean trenches, frequently in outmoded vessels, and then often detonated. This practice, however, has been largely abolished.

The National Oceanic and Atmospheric Administration (NOAA) conducts a comprehensive program of research and monitoring on ocean dumping and reports annually to Congress. NOAA has studied principal and alternative sewage sludge dump sites in the New York Bight.[89] Their studies indicate that natural discharges and 40 years of dumping have produced a stable distribution of organic muds in the Bight.

Studies are also underway to determine the bacteriological and physiological effects of dumping. Based on field investigation, potential impacts of sludge dumping are an increased incidence of fin rot in fishes in offshore areas, pathogen contamination of sediments and overlying waters, alteration in migratory patterns of certain fishes, increased concentration of several heavy metals in fish and shellfish, and food web modification and localized effects on plankton.

In 1973 and 1974, EPA conducted studies at the Philadelphia municipal sewage sludge dumping site about 40 miles east of Ocean City. Metals in the sediments indicated that the affected area may be greater than previously suspected, and that there may be toxic persistence and accumulation of 11 of 13 toxic metals in shellfish and sediments. Mortality was noted in one clam species. Tests for total

TABLE II-13. Types and amounts (thousands of tons) of vessel-discharged ocean disposal (Source: U.S. Environmental Protection Agency) [a]

Waste type	Atlantic			Gulf			Pacific			Total		
	1973	1974	1975	1973	1974	1975	1973	1974	1975	1973	1974	1975
Industrial waste	3,643	3,642	3,322	1,408	950	124	0	0	0	5.059	4.592	3,446
Sewage sludge	4,899	5,010	5,040	0	0	0	0	0	0	4.899	5.010	5,040
Construction and demolition debris	974	770	396	0	0	0	0	0	0	974	770	396
Solid waste	0	0	0	0	0	0	0.2	0.2	0	0.2	0.2	0
Explosives	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	**9,515**	**9,422**	**8,758**	**1,408**	**950**	**124**	**0.2**	**0.2**	**0**	**10,924**	**10,373**	**8,882**
Dredged materials										**44,208**	**98,665**	**87,826**
Total										**55,132**	**109,038**	**96,708**
Change over past year, %											**+96**	**−11**

[a] Data may not add to total because of rounding.

and fecal coliform bacteria indicated no major coliform bacterial buildup in bottom waters or sediments.[95]

Direct ocean dumping represents only a small part, perhaps as little as 10 percent, of the total human-related waste entering the nation's coastal waters. This small part is often concentrated from large volumes of wastewater, however, and is therefore a potentially serious contaminant.

CONCLUSION

The commitment to protect and improve the nation's water quality was significantly expanded at the beginning of this decade and has since been pursued with substantial efforts. Progress has been made in controlling municipal and industrial point sources of pollution. Major improvements in the quality of polluted streams have been documented in the preceding pages and in CEQ's previous Annual Reports.

However, if the national water quality goals are to be met, we must recognize that some of the most difficult water pollution abatement problems are still ahead of us. Land surface runoff, atmospheric transport, and other diffuse sources of water pollution are substantial, pervasive, and difficult to control. As we continue to make progress in cleaning up point sources, the nonpoint sources will become even more important as sources of nutrients, toxic materials, and other pollutants. Now we face the formidable task of dealing with these diffuse sources, without abandoning the proven successes and hard-won gains of point-source abatement.

ENVIRONMENTAL INDICATORS

PEOPLE AND THE LAND: GROWTH OF NONMETROPOLITAN AREAS IN THE UNITED STATES

Even with the greatly reduced birth rates and the overall slackening of population growth in the United States, the U.S. population, currently at 215 million, will probably grow by some 47 million people within the next 24 years. Where will these projected 262 million people choose to live? What stresses will their choices place on the natural environment?

As hard as it is to project population growth, it is even more difficult to project the distribution patterns of the American people. Americans are movers; if things look better elsewhere, they go. Throughout our 200-year history, the dominant shift has been from rural to urban living. This pattern has become so pervasive that by 1970, 73.0 percent of the population lived within the county boundaries of large metropolitan areas.

There are three important patterns of population distribution evident in the United States in the 1970's, each with its own implications for the future. The dominant pattern of population settlement continues to be the growth of major metropolitan areas, a trend that accelerated in the post World War II period, but which has now slowed appreciably. The second pattern is a considerable regional shift of population from the north central and northeastern sections of the country to the southern and western regions. The third pattern is a more recently observed phenomenon: the relatively rapid growth of population in nonmetropolitan areas. We have chosen to highlight this pattern in the Annual Report because it is a growing trend that runs contrary to the basic pattern of growth throughout most of our history. For the first time, population in nonmetropolitan areas is increasing faster than that in metropolitan areas.

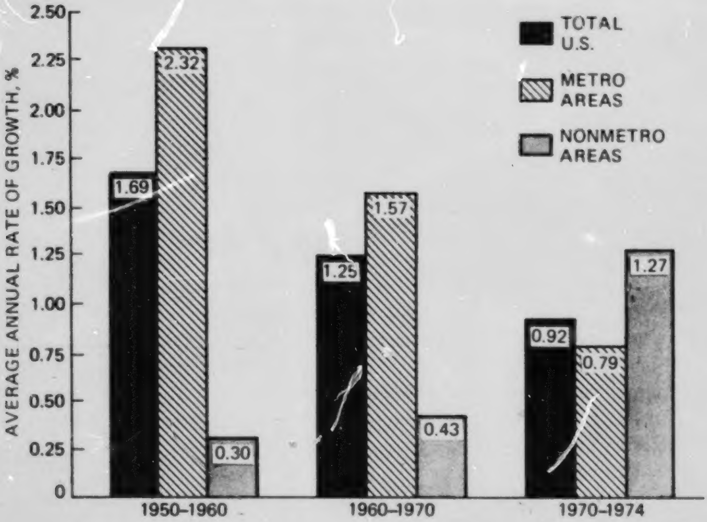
The environmental implications of this growth pattern are hard to predict. In many cases, nonmetropolitan growth will become metropolitan in character, and the environmental stresses (natural resource use, energy use, water and air pollution, noise, etc.) probably will follow the patterns of the rest of urban America. However, to the extent that the nonmetropolitan growth is what we call rural growth, with little increase in urban character, then the stresses on the natural environment through different land use patterns and natural resource use and development are not well documented.

Population Growth in Nonmetropolitan Areas

- For the first time in U.S. history, nonmetropolitan areas of the United States are growing in population faster than metropolitan areas. Between April 1970 and July 1974, nonmetropolitan counties grew 5.6 percent. During the same time, metropolitan areas grew 3.4 percent, and the U.S. population as a whole increased 4.0 percent. These increases have resulted in an average annual rate of population growth of 1.28 percent for nonmetropolitan areas, 0.79 percent for metropolitan areas, and 0.92 percent per year for the United States as a whole.

The United States has 3,097 counties. In 1975 about 2,500 were nonmetropolitan. A metropolitan county is part of a Standard Metropolitan Statistical Area (SMSA), defined essentially as an area with an urban center of 50,000 persons or more and neighboring commuter counties of metropolitan character. Nonmetropolitan communities thus include all counties not part of an SMSA. Although nonmetropolitan counties comprise 79 percent of total U.S. counties and 85 percent of the land area, as of 1975 they contained only 27 percent of the U.S. population.

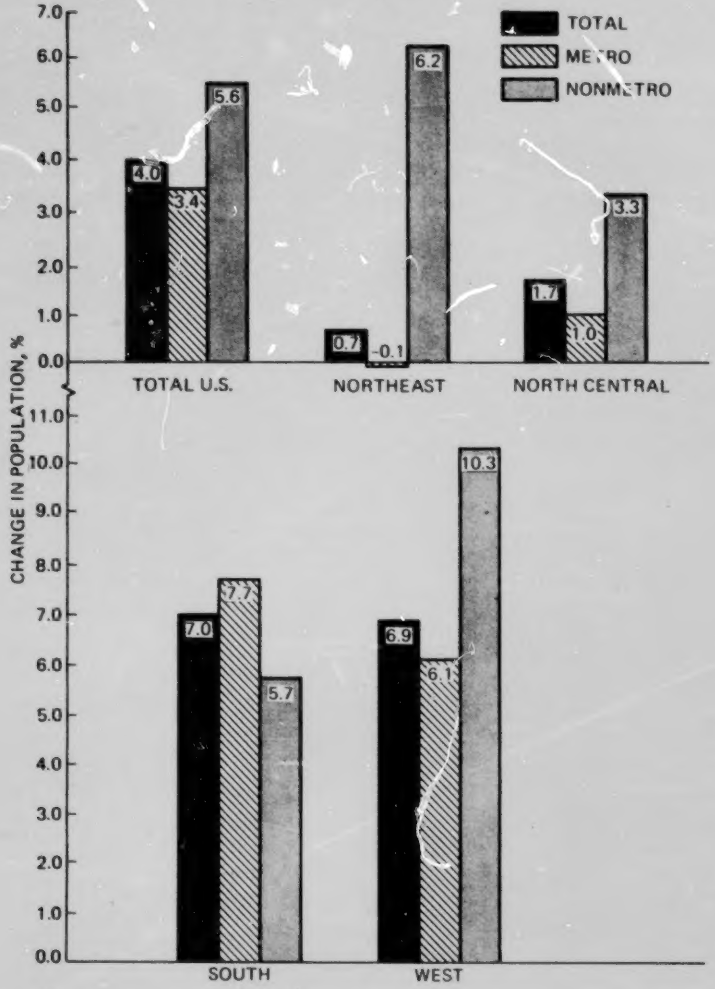
POPULATION GROWTH IN METROPOLITAN AND NONMETROPOLITAN AREAS: 1950–1974



Sources: Beale, Calvin L., and Fuguitt, Glenn V., "The New Pattern of Nonmetropolitan Population Change," Center for Demography and Ecology, University of Wisconsin (1975). Forstall, Richard L., Population Division, Bureau of the Census, "Trends in Metropolitan and Nonmetropolitan Population Growth Since 1970" (May 1975); 1974 data issued February 1976.

- Nonmetropolitan growth has taken place in all major regions of the United States. The West shows the highest rate of growth from 1970 to 1974. The Northeast shows the largest rate of growth relative to metropolitan growth.

POPULATION GROWTH IN METROPOLITAN AND NONMETROPOLITAN AREAS, BY REGION: 1970-1974



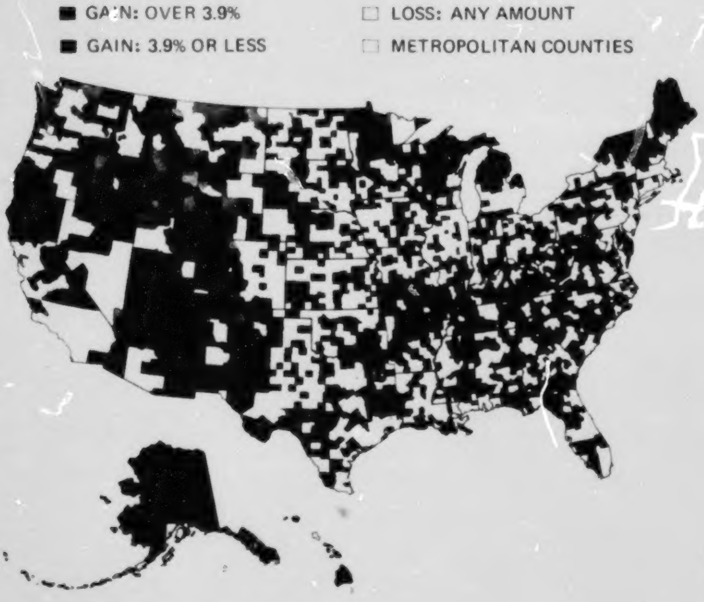
Source: Prepared by the U.S. Department of Agriculture, Economic Research Service, based on reports by the U.S. Department of Commerce, Bureau of the Census (1976).

- Population growth in nonmetropolitan areas, as shown by county, is both substantial and widespread, occurring in 46 of the 50 states.

This shift in growth was first measured in the mid-1960's in such areas as the upper Great Lakes cutover lands, the Ozarks, Tennessee Valley, and Texas hill country, and now includes many areas of the West and South. Most of these same areas were losing population during the period from 1950 to 1960.

Nonmetropolitan counties that still show no growth in population are located mainly in the Great Plains, the delta area of the Mississippi, and the western Corn Belt.

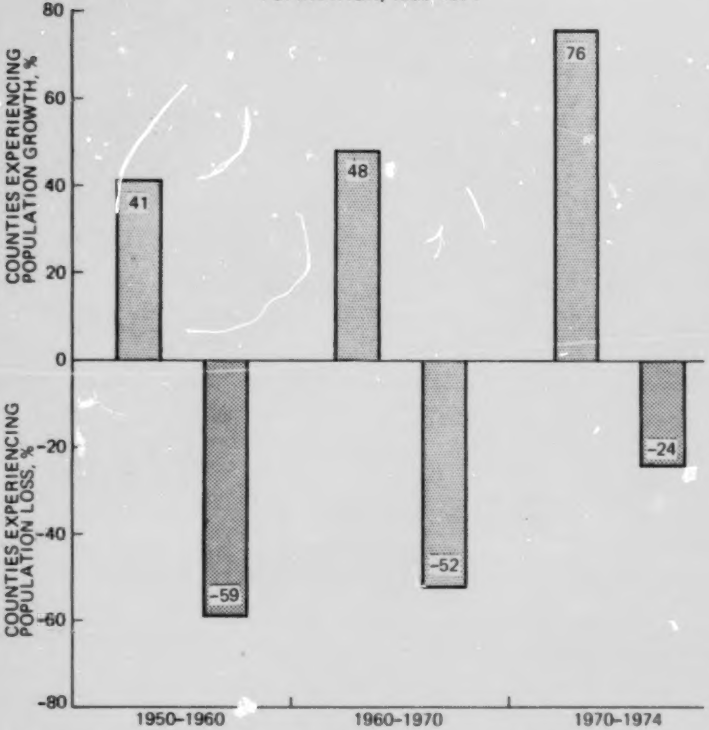
POPULATION CHANGE FOR NONMETROPOLITAN COUNTIES: 1970-1974



Source: U.S. Department of Commerce, Bureau of the Census.

- From 1970 to 1974, more than 75 percent of our nonmetropolitan counties experienced growth. Most of those counties continuing to lose population did so at a slower rate than in the 1960's.

NONMETROPOLITAN COUNTIES EXPERIENCING GROWTH IN POPULATION, 1950–1974



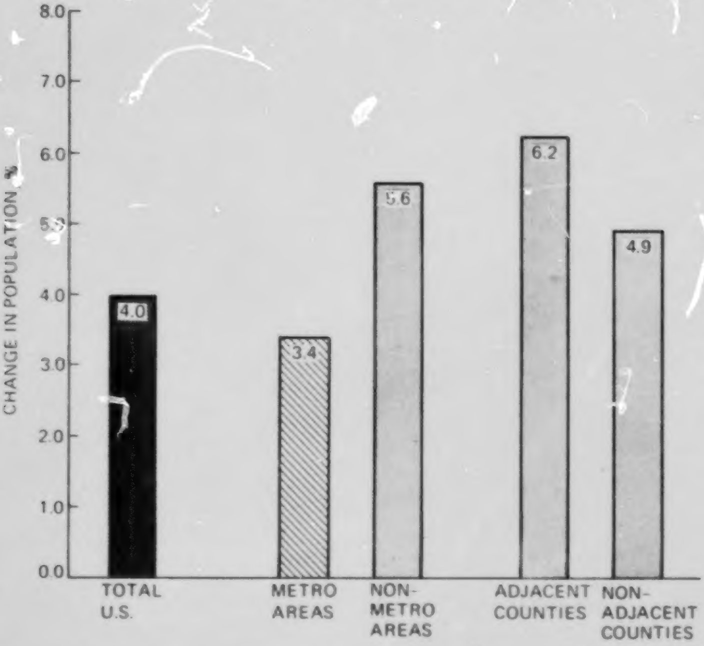
Source: Beale, Calvin L., U.S. Department of Agriculture, Economic Research Service, "The Revival of Population Growth in Nonmetropolitan America" (June 1975), ERS-605, and unpublished data.

- Population growth is taking place in counties both adjacent and not adjacent to metropolitan areas.

  Counties adjacent to metropolitan areas have had the higher population growth rate since 1970—6.2 percent—and have acquired five-eighths of the total net in-migration into all nonmetropolitan counties. In adjacent counties, the decentralization trend seems to be a continuation of low-density urban sprawl, with the new growth eventually absorbed into existing and some newly formed metropolitan areas. Nonadjacent counties are also growing, and their growth rate is significantly higher than that of the total population.

  As of 1970, there were 969 adjacent counties and 1500 nonadjacent counties. The nonadjacent counties contained 27.4 million persons or 13.1 percent of the total U.S. population (48.4 percent of the total nonmetropolitan population).

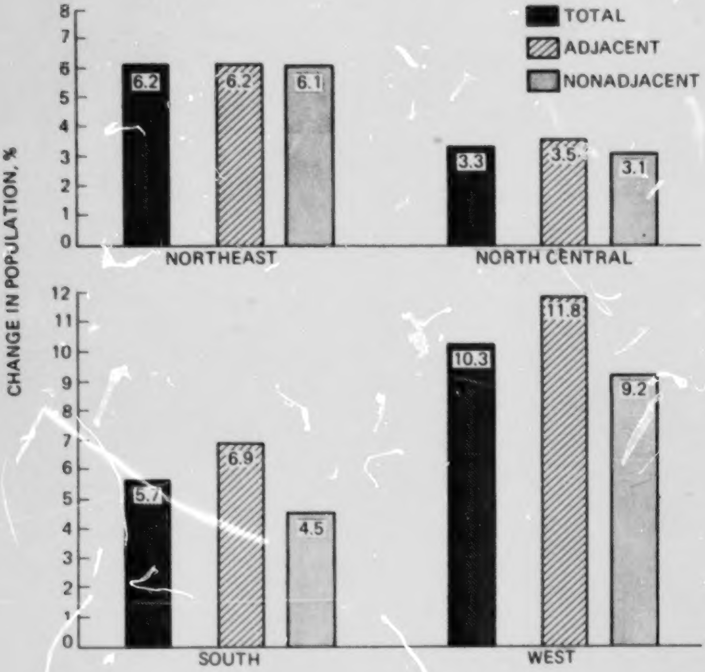
POPULATION GROWTH IN NONMETROPOLITAN COUNTIES
ADJACENT AND NOT ADJACENT TO METROPOLITAN AREAS: 1970-1974



Sources: Beale, Calvin L., U.S. Department of Agriculture, Economic Research Service, "The Revival of Population Growth in Nonmetropolitan America" (June 1975), ERS-605. Forstall, Richard L., Population Division, Bureau of the Census, "Trends in Metropolitan and Nonmetropolitan Population Growth Since 1970" (May 1975) - 1974 data issued February 1976.

- Adjacent counties in all regions are growing slightly faster than the more isolated nonadjacent areas.

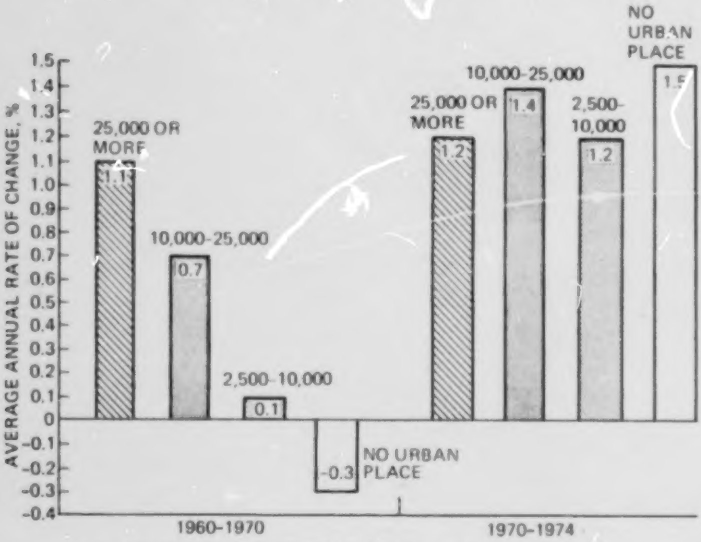
POPULATION GROWTH IN ADJACENT AND NONADJACENT NONMETROPOLITAN COUNTIES, BY REGION: 1970-1974



Source: Beale, Calvin L., U.S. Department of Agriculture, Economic Research Service, "The Revival of Population Growth in Nonmetropolitan America" (June 1975), ERS-605.

- Nonmetropolitan counties with small towns and villages and those with no town of more than 2,500 residents—the most rural areas of the country—are now growing as fast as counties with much larger towns. In fact, the growth in these rural areas in recent years is largely responsible for nonmetropolitan areas now growing faster than metropolitan areas.

POPULATION GROWTH IN NONMETROPOLITAN COUNTIES BY SIZE OF LARGEST TOWN IN COUNTY: 1960-1970 AND 1970-1974

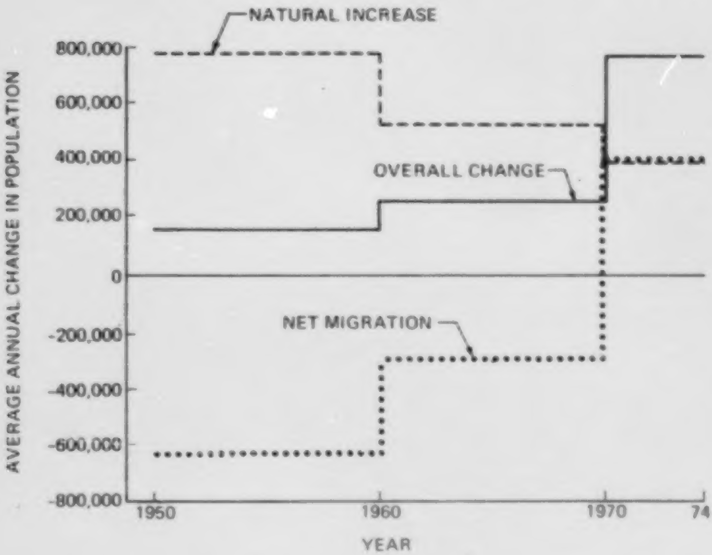


Source: Beale, Calvin L., U.S. Department of Agriculture, Economic Research Service, (unpublished data, May 1976).

- The most important factor in the recent increase in nonmetropolitan growth is net in-migration, which results when more people move into an area than move out. Population growth occurs through natural increase (more births than deaths), or net in-migration, or both.

From 1970 to 1974, approximately 1.6 million more people moved into nonmetropolitan areas than left them. This is in direct contrast to previous trends. In the 1960's, nonmetropolitan areas lost 2.9 million and in the 1950's, 6.3 million through net out-migration.

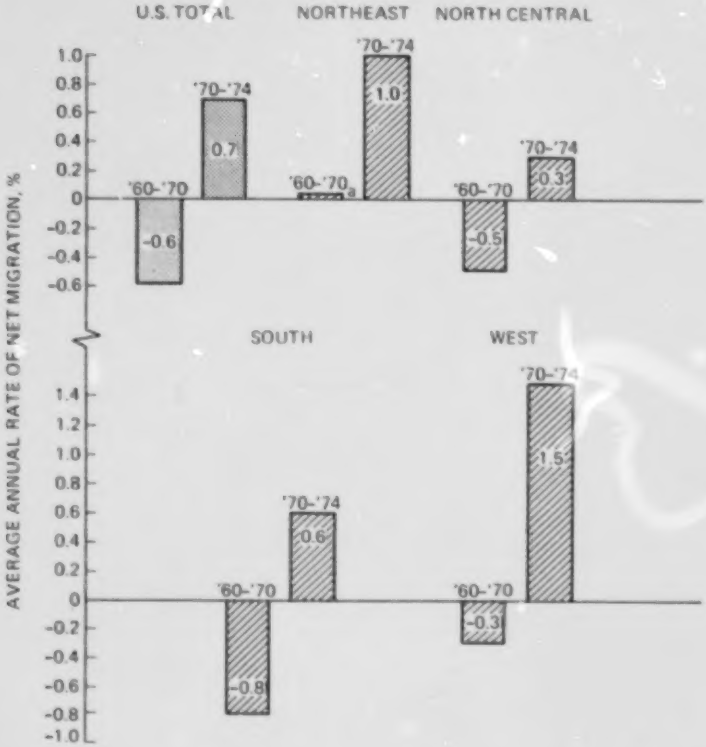
AVERAGE ANNUAL CHANGE
IN NONMETROPOLITAN POPULATION: 1950-1974



Source: Beale, Calvin L., and Fuguitt, Glenn V., "The New Pattern of Nonmetropolitan Population Change," Center for Demography and Ecology, University of Wisconsin (1975).

- Increased in-migration has been registered in all major regions of the country.

NET MIGRATION TO NONMETROPOLITAN COUNTIES
BY REGION: 1960–1970 AND 1970–1974

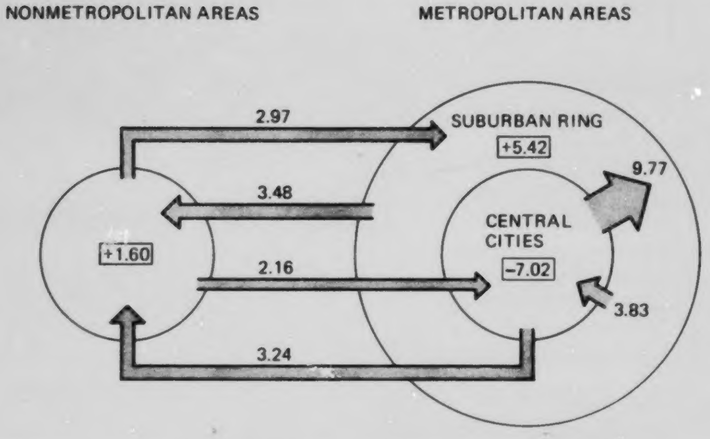


[a] Less than 0.05.

Source: Prepared by U.S. Department of Agriculture, Economic Research Service, based on reports by the Bureau of the Census.

- The flow of people into nonmetropolitan areas is about equally divided between those coming from central cities and those from suburban areas.

POPULATION MIGRATION[a] (IN MILLIONS): 1970-1974


NONMETROPOLITAN AREAS
METROPOLITAN AREAS
2.97
SUBURBAN RING
+5.42
9.77
3.48
CENTRAL CITIES
+1.60
2.16
−7.02
3.83
3.24

---

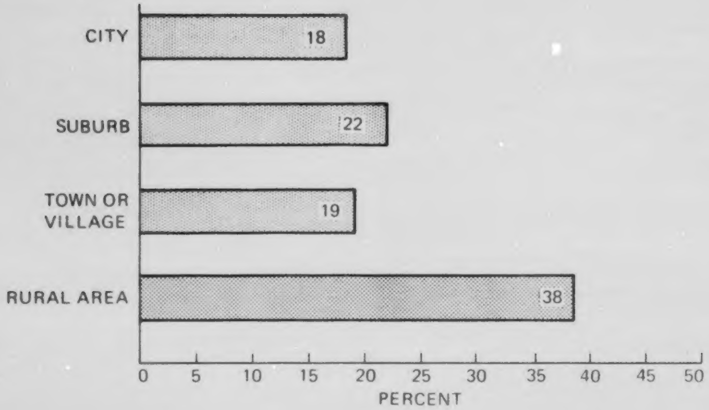
[a] Chart refers only to individuals living in the United States in both 1970 and 1974, and thus does not include migration from outside the United States.

Source: U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-20, No. 285, p. 2.

Factors Influencing Nonmetropolitan Growth

- A large proportion of the American people now expresses a preference for living in a rural area.

PREFERRED PLACE OF RESIDENCE: 1972

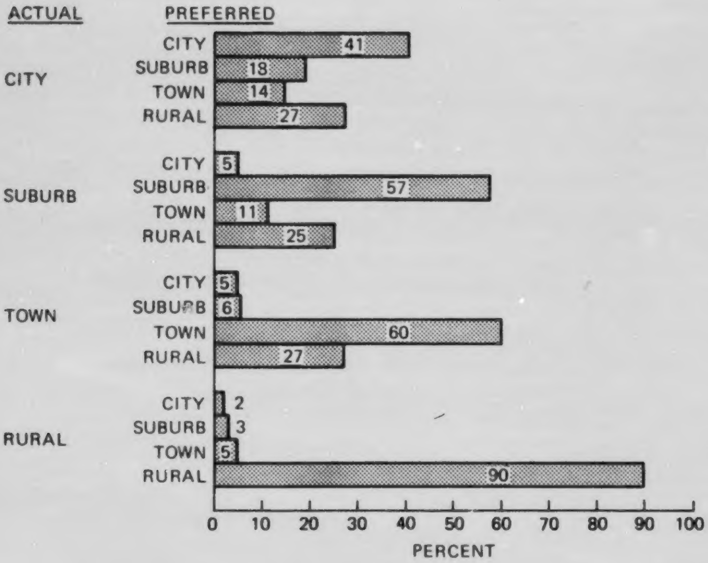


Based on a national survey of 1802 individuals conducted by the Gallup Organization in June 1972. Respondents were asked: "If you could live anywhere you wanted to, which one of these kinds of places listed . . . would be your very first choice? In a city, in the suburbs, in a town or village, in a rural area out in the country." (Three percent responded "Don't know.")

Source: Watts, William, and Free, Lloyd A., Eds., *State of the Nation* (New York: Universe Books, 1973), p. 81.

- People who actually live in rural areas express the highest level of preference for their area of residence. Although city dwellers, suburban residents, and town residents also express a preference for their areas (but at a lower level), in each case the second most preferred place of residence is a rural area.

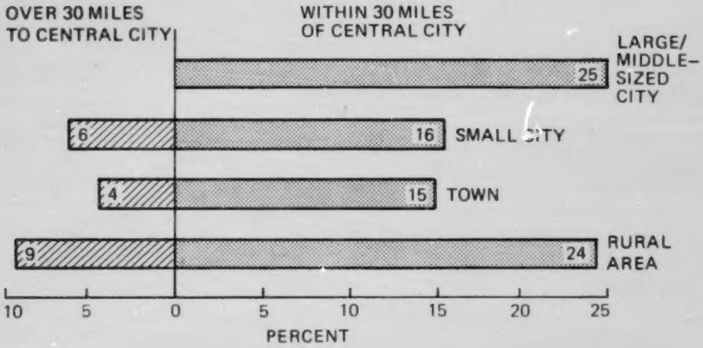
PREFERRED PLACE OF RESIDENCE
BY ACTUAL PLACE OF RESIDENCE: 1972



Source: Watts, William, and Free, Lloyd A., Eds., *State of the Nation* (New York: Universe Books, 1973), p. 82.

- Although many people say that a rural area is their preferred area of residence, they want that area to be close to a metropolitan center. In a national survey taken in 1972, 74 percent expressed a desire to live in a small city, town, or rural area, but only 19 percent wanted that residence to be more than 30 miles from a central city.

PREFERRED PLACE OF RESIDENCE
BY PROXIMITY TO LARGE CITY: 1972

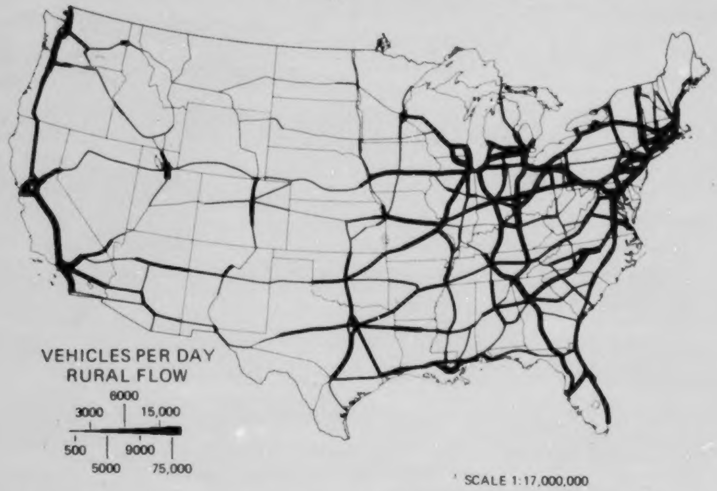


Source: Fuguitt, Glenn V., and Zuiches, James J., "Residential Preferences and Population Distribution," *Demography*, Vol. 12 (August 1975), p. 495.

- One of the most important and least understood developments influencing population distribution in the United States is the construction of the Interstate Highway System and the major state and local highways that connect to it. That system, begun in 1956, is now 88 percent complete.

The amount of traffic along the rural sections of the Interstate Highway System increased rapidly during the 1960's, the same decade in which commuting and intercity travel by rail declined substantially.

AVERAGE DAILY TRAFFIC FLOW ON THE INTERSTATE SYSTEM: 1967

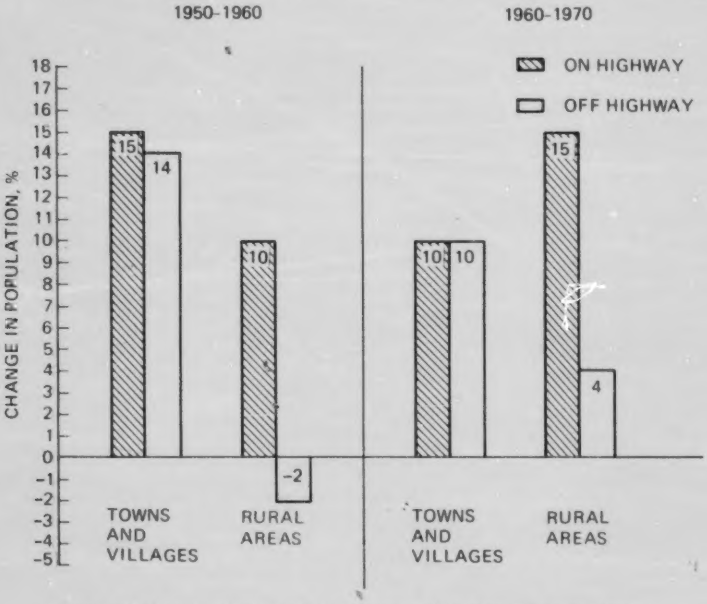

VEHICLES PER DAY
RURAL FLOW
6000
3000
15,000
500
9000
5000
75,000
SCALE 1:17,000,000

Source: U.S. Department of the Interior, Geological Survey, *The National Atlas of the United States* (1970), p. 227.

- Total nonmetropolitan population grew twice as rapidly in counties on the Interstate Highway System as in other counties. Most of the growth effect occurred in rural areas.

  The growth advantage of counties located on an interstate highway was similar in both the 1950's and the 1960's, yet only 25 percent of the system was completed by 1960. This suggests that differences in growth cannot be viewed as solely an effect of the interstate, but that perhaps the reverse is true. Interstates have been built along major traffic corridors that correspond with development and population growth.

THE INTERSTATE HIGHWAY SYSTEM AND POPULATION GROWTH IN NONMETROPOLITAN AREAS: 1950-1970

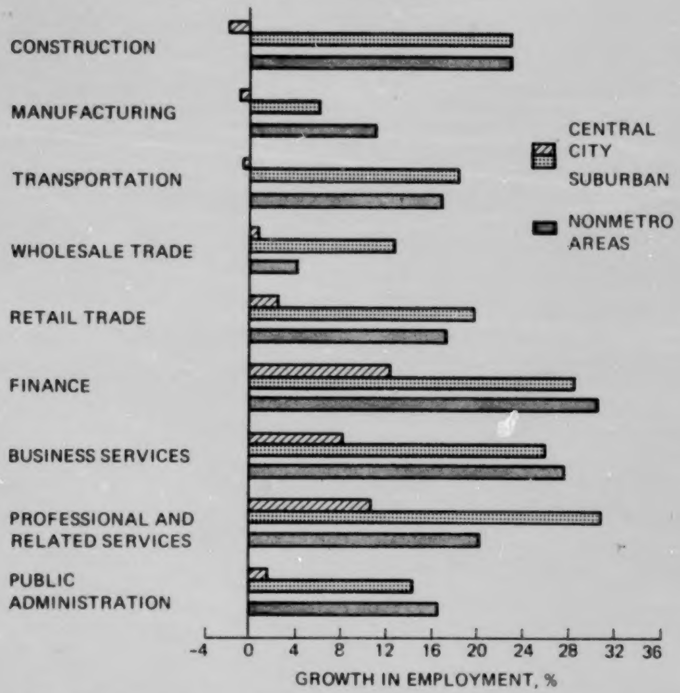


Source: Fuguitt, Glenn V., and Beale, Calvin L., U.S. Department of Agriculture, "Population Change in Nonmetropolitan Cities and Towns," Report No. 323 (February 1976), p. 12.

- Agriculture and related industries are no longer the only major sources of employment for those living in nonmetropolitan areas. Agriculture ranks fourth in size of work force, behind manufacturing, professional and related services, and retail trade.

There is a striking difference between the growth of industries in nonmetropolitan areas and the decline of industries in central cities. This change has been particularly evident in manufacturing and construction, which used to be the strongest sectors or urban employment. In general, nonmetropolitan employment has been growing faster than metropolitan employment since 1965.

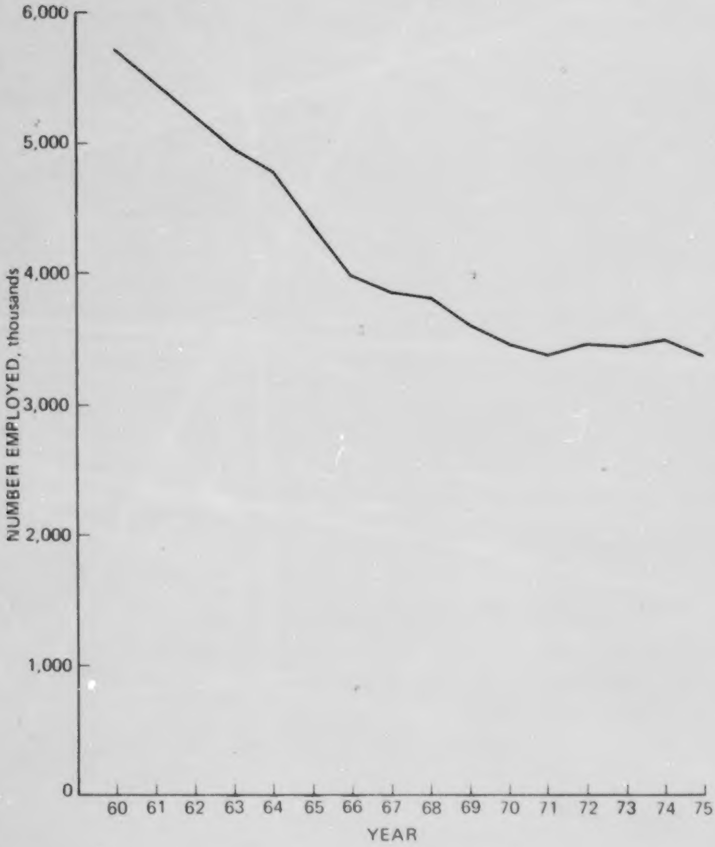
EMPLOYMENT GROWTH IN SELECTED INDUSTRIES BY AREA OF RESIDENCE: 1970–1974



Source: U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-23, No. 55, pp. 84-85.

- Movement of farmers and their families off the land since the 1920's seems to have stopped, and the agricultural sector is no longer losing jobs.

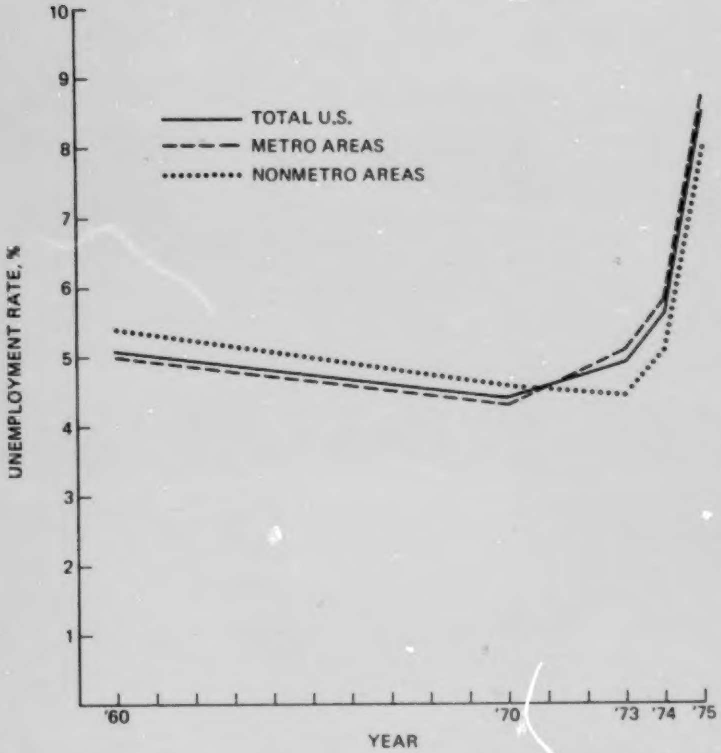
WORKERS IN AGRICULTURE: 1960-1975



Source: Bureau of Labor Statistics, *Monthly Labor Review*, 1960-1976. Tables on "Selected Employment Indicators" and "Employment and Unemployment."

- Unemployment levels in nonmetropolitan areas are now below rates found in metropolitan areas.

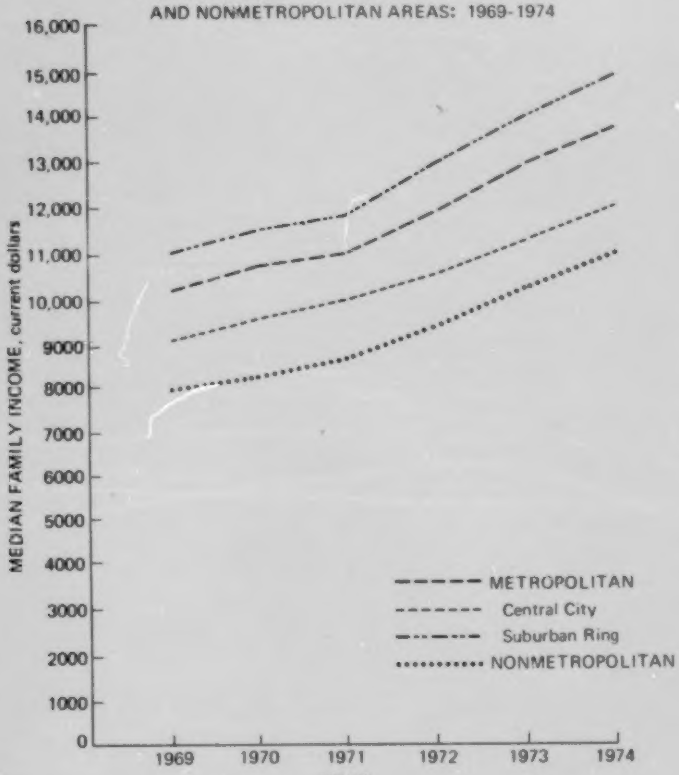
UNEMPLOYMENT RATES FOR METROPOLITAN AND NONMETROPOLITAN AREAS: 1960–1975



Sources: U.S. Department of Commerce, Bureau of the Census, U.S. Census of Population, *U.S. Summary: 1960*, PC(1)-C1, Table 101; 1970, PC(1)-C1, Table 112. U.S. Department of Labor, *Manpower Report of the President, 1975* and *Employment and Training Report of the President, 1976*.

- Incomes in nonmetropolitan areas have increased faster than incomes in metropolitan areas. Nonmetropolitan families on the average had incomes of about $11,045 in 1974—20 percent below the level for metropolitan families. Nonmetropolitan incomes are only 8 percent below the incomes of people living in central cities, where the cost of living is higher.

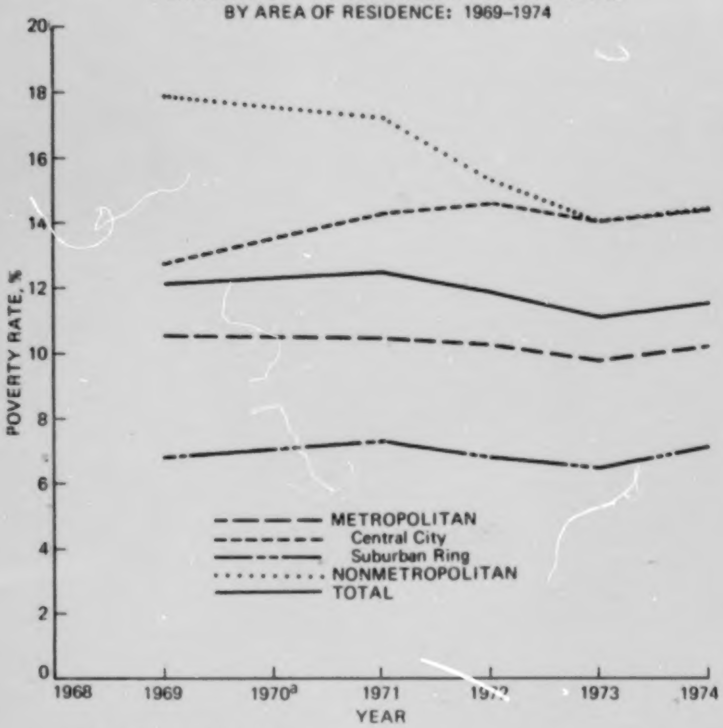
MEDIAN FAMILY INCOME FOR METROPOLITAN AND NONMETROPOLITAN AREAS: 1969-1974



Source: U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-60, No. 75, p. 32; No. 80, p. 30; No. 85, p. 40; No. 90, p. 48; No. 97, p. 46; No. 101, p. 40.

- Poverty in nonmetropolitan areas has dropped substantially as job opportunities and income levels have increased. The percentage of people with incomes below the poverty line in nonmetropolitan areas is equal to the percentage in central cities.

PERCENTAGE OF PERSONS BELOW POVERTY LEVEL
BY AREA OF RESIDENCE: 1969–1974



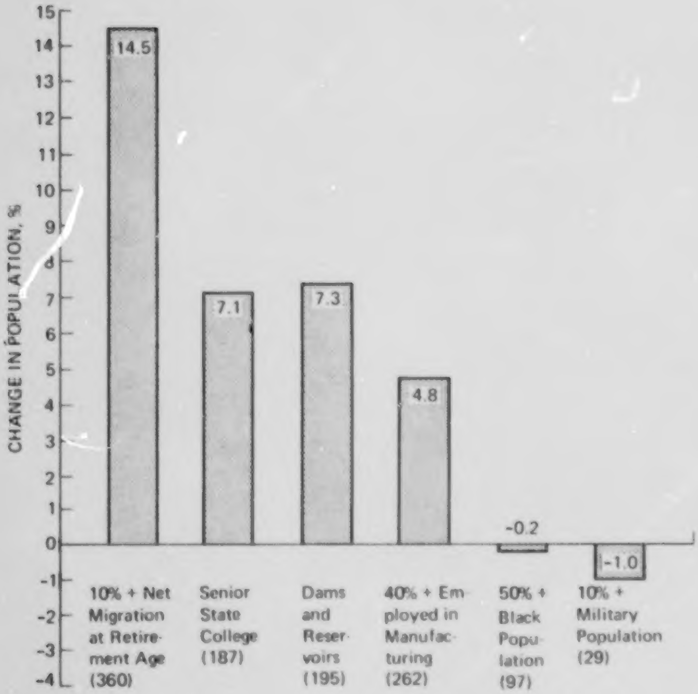
ªData for 1970 are not available.

Source: U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-60, No. 102, p. 19.

- Manufacturing jobs provided the most important stimulus for the economic revival of nonmetropolitan areas in the late 1960's. Now other industries and other factors are influencing population growth.

So-called retirement counties have exhibited remarkable growth during recent years. Many are located in such traditional retirement areas as Arizona, Florida, and Cape Cod, but in recent years retirement settlements have spread to other regions—the east Texas coastal plain, the hill country of central Texas, the Ozarks, the Sierra Nevada foothills in California, and the upper Great Lakes, especially in northern Michigan. In general, coasts, lakes, reservoirs, and hills are favorite locations. These retirement areas include 8.7 million people in 360 counties and comprise an increasingly significant part of the total nonmetropolitan population.

POPULATION GROWTH IN NONMETROPOLITAN COUNTIES WITH SELECTED CHARACTERISTICS: 1970–1974



( ) = Number of Counties

Source: Prepared by the U.S. Department of Agriculture, Economic Research Service, based on reports by the Bureau of the Census (1976).

An equal number of nonmetropolitan people live in counties having state colleges and universities. The rise of nonmetropolitan state schools has greatly increased availability and quality of higher education in nonmetropolitan areas and has also made the towns more attractive for other development. (Lists of retirement and college counties are almost mutually exclusive. Only 19 counties are in both categories.)

TIMBER RESOURCES [96]

In 1970, 1.6 billion acres (69 percent) of the nation's 2.3 billion-acre area was classified as forest and range. Some 754 million acres was classified as forest land, of which 500 million acres was classified as commercial forest land, i.e., available for and capable of growing wood at the rate of at least 20 cubic feet per acre per year. Additional areas of productive timberland in public ownership (parks, wilderness, refuges, etc.) on which timber harvesting is excluded were classed as "reserved" areas. These totaled 17.2 million acres in 1970. Most of the balance of the nation's forest lands—236 million acres—is too poor in quality to grow trees as a commercial crop. However, it is valuable for other purposes such as watershed, fish and wildlife habitat, grazing, and recreation.

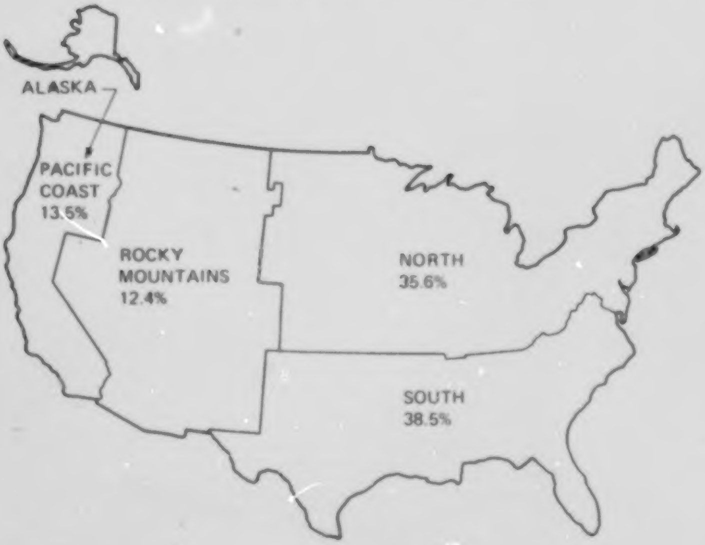
- The East contains almost three-fourths of the commercial U.S. timberland, almost equally divided between North and South. The other one-fourth is located principally in the Pacific Coast and Rocky Mountain states.

The 500 million acres of land classified as commercial timberland in 1970 is 8.4 million acres less than estimated for 1962. The decline is largely in the South and in the Rocky Mountain areas of the West. In the South, the decline represents lands converted to agricultural use. In the West, some National Forest lands were shifted from timber to other uses based on a reevaluation of the commercial forestland base. Projections through 2020 show a continued loss of commercial forest land at a rate of about ½ million acres per year. This loss is due to changes in land use, including withdrawals of land for parks and other recreation areas, urban development, crop land expansion, highways, reservoirs, and other non-timber uses.

WHERE IS THE COMMERCIAL TIMBERLAND?

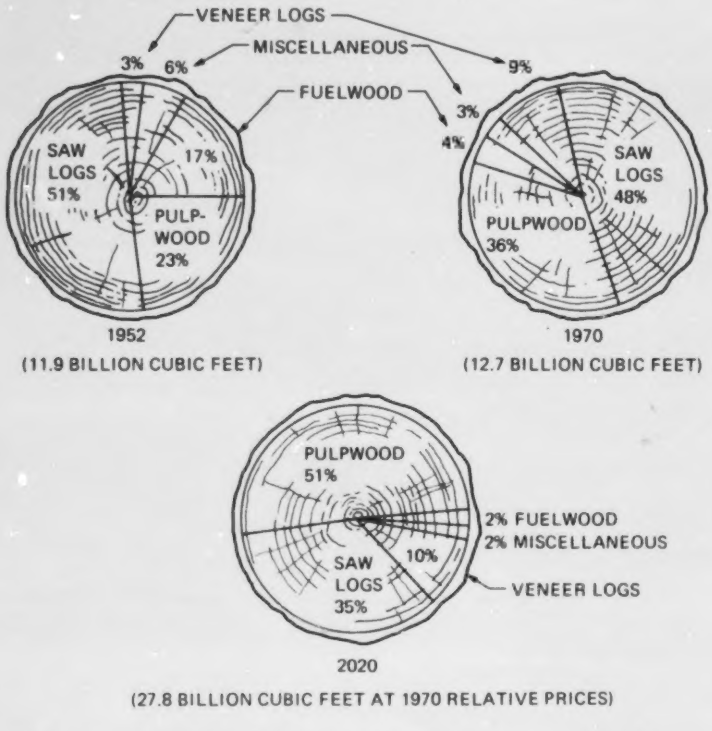
THREE-FOURTHS IN THE EAST: ONE-HALF IN THE NORTH
ONE-HALF IN THE SOUTH

ONE-FOURTH IN THE WEST (INCLUDING ALASKA)



- Americans used almost 13.1 billion cubic feet of timber products in 1974, such as saw logs for lumber, pulpwood for paper, fuelwood, posts, poles, piling, and other logs and bolts from which veneer is made. Before 1970, saw logs accounted for almost half of the consumption of the major wood products. Proportional future demand for saw logs however, will shrink while that for pulpwood will expand.

WHERE THE TIMBER GOES: U.S. ROUNDWOOD CONSUMPTION BY MAJOR PRODUCTS



CONSUMPTION TO 2020 WILL FOLLOW PAST TRENDS: SAW LOG DEMAND WILL SHRINK; THAT FOR PULPWOOD WILL EXPAND

- Major timber product markets are residential construction (housing), nonresidential construction, manufacturing, and shipping. Housing is the most important of these in terms of the volume of products consumed. In 1970, about two-fifths of the lumber and board, and about one-half of the plywood was used for production, upkeep, and maintenance of housing. Demand for lumber and panel products is expected to increase. In terms of volume, the largest increase for lumber is in shipping; for plywood, in housing; and for boards, in manufacturing.

CONSUMPTION OF LUMBER, PLYWOOD, AND BOARDS BY MAJOR END USES

WOOD PRODUCT AND YEAR	PER CAPITA AVERAGE	TOTAL AMOUNT	SPECIES		NEW HOUSING	RESIDENTIAL UPKEEP AND IMPROVEMENT	NEW NONRESIDENTIAL CONSTRUCTION	MANUFACTURING	SHIPPING	ALL OTHER
			SOFTWOOD	HARDWOOD						
	BOARD FEET				BILLION BOARD FEET					
LUMBER										
1970	193	39.5	32.1	7.3	12.3	4.7	3.7	4.7	5.7	8.4
2020	227	67.6	52.7	14.9	17.2	7.8	7.3	9.6	11.6	14.1
	SQUARE FEET[a]				BILLION SQUARE FEET					
PLYWOOD										
1970	87	17.8	14.0	3.8	6.3	2.5	1.7	1.7	–	5.6
2020	154	45.9	35.8	10.1	12.5	5.9	6.2	6.8	–	14.5
	SQUARE FEET[a]				BILLION SQUARE FEET					
BOARDS[b]										
1970	47	9.6	–	–	2.8	1.4	0.9	1.8	–	2.7
2020	141	41.9	–	–	7.2	3.9	2.0	16.2	–	12.6

[a] 3/8-in. basis.

[b] Includes insulation board, hardboard, and particle board.

- Not all of what we use in wood products is produced by our own forests: imports in 1970 were almost twice exports and almost 20 percent of total use. Depending on price situations in 2000, imports could be as much as 28 percent of the total use. Most of the U.S. export trade has been with Japan and Europe. Major product categories are logs, pulpwood chips and woodpulp to Japan, and lumber, paperboard, and woodpulp to Europe. Imports have been chiefly softwood lumber, newsprint and woodpulp, mostly from Canada. These trends are expected to continue.

ROUNDWOOD CONSUMED: EXPORTS, IMPORTS AND PRODUCTION FROM U.S. FORESTS

BILLION CUBIC FEET

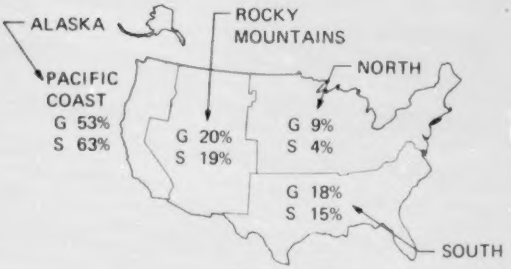
	1952	1970	2000[a]	2000[b]
DOMESTIC PRODUCTION	10.8	11.7	21.3	15.7
IMPORTED	1.4	2.4	3.1	5.0
EXPORTED	0.2	1.4	2.4	2.5
TOTAL U.S. CONSUMPTION	11.9	12.7	22.0	18.2

[a] At 1970 relative prices for wood products.

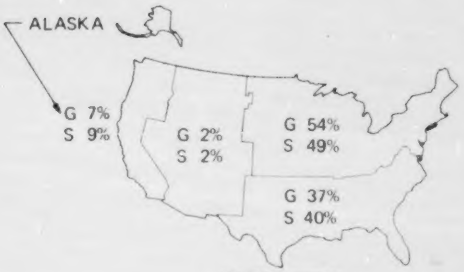
[b] At rising relative prices for wood products.

- The timber resources base today is 649 billion cubic feet of growing stock, including 2421 billion board feet of sawtimber-sized trees. Softwood comprises two-thirds of the growing stock and four-fifths of the sawtimber and is heavily concentrated in the West, where there are extensive stands of old growth timber containing high volumes per acre. Hardwoods are located primarily in the East, with volume about equally divided between North and South.

GEOGRAPHIC DISTRIBUTION OF GROWING STOCK AND SAWTIMBER INVENTORY
(G = GROWING STOCK, S = SAWTIMBER)


ALASKA
ROCKY MOUNTAINS
NORTH
PACIFIC COAST
G 53%
S 63%
G 20%
S 19%
G 9%
S 4%
G 18%
S 15%
SOUTH

SOFTWOODS

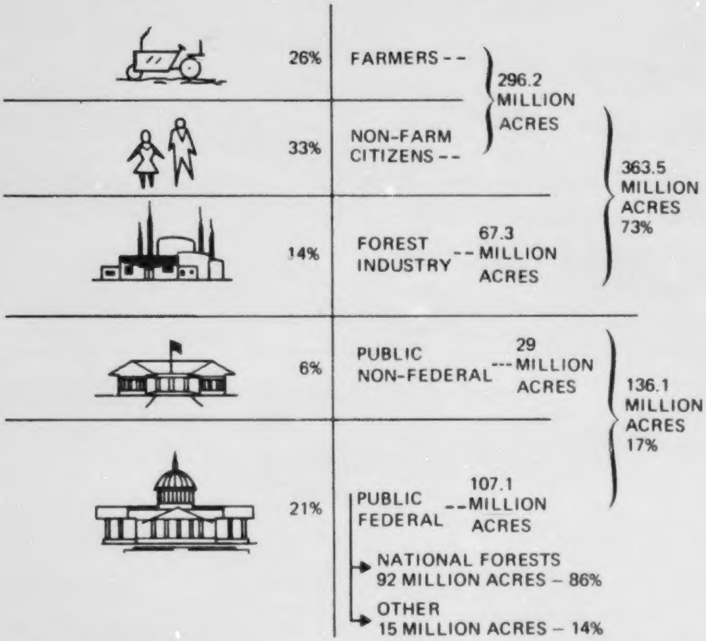

ALASKA
G 7%
S 9%
G 2%
S 2%
G 54%
S 49%
G 37%
S 40%

HARDWOODS

- Most U.S. timberland is privately owned by farmers, business, and professional people, and others not associated with any forest industry. There are about 4 million such private ownerships, with few individual acreages averaging more than 100 acres. However, their aggregate timber inventory is about 41 percent of the nation's total growing stock and 31 percent of the total sawtimber.

  Most of the softwood timber inventory is in the National Forests, which includes 46 percent of all softwood growing stock and 51 percent of all softwood sawtimber. Only 8 percent of all hardwood growing stock is in the National Forests. Most of the hardwood inventory, 71 percent, is contained on farm and miscellaneous ownerships.

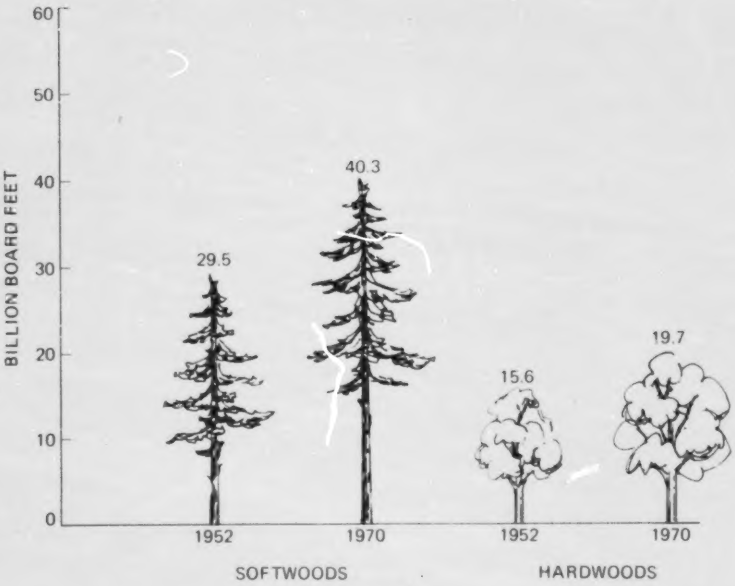
WHO OWNS THE TIMBERLANDS?


26%
FARMERS --
33%
NON-FARM CITIZENS --
296.2 MILLION ACRES
14%
FOREST INDUSTRY -- 67.3 MILLION ACRES
363.5 MILLION ACRES 73%
6%
PUBLIC NON-FEDERAL --- 29 MILLION ACRES
136.1 MILLION ACRES 17%
21%
PUBLIC FEDERAL -- 107.1 MILLION ACRES
NATIONAL FORESTS
92 MILLION ACRES – 86%
OTHER
15 MILLION ACRES – 14%

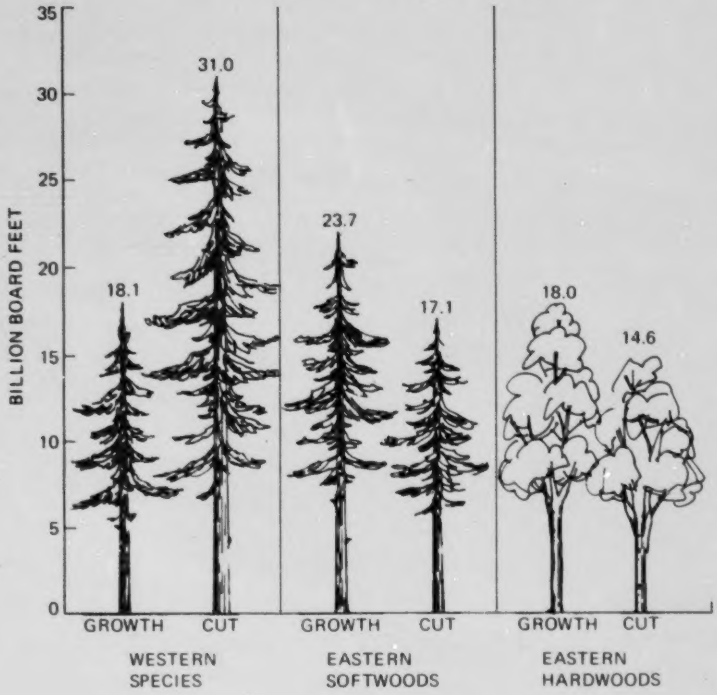
- Trends in net annual timber growth (i.e., total annual growth less mortality) shows that the net annual growth of softwoods and hardwoods combined increased by 18 percent between 1952 and 1962 and another 14 percent between 1962 and 1970. This increase is a result of expanded programs in forest fire control, tree planting, and other forestry measures.

  No ownership class of commercial forest timberland is growing wood at its potential capacity. This is due in part to partial stocking of trees on much of the forest areas, mortality and growth losses from destructive agents, and presence of cull trees and brush which limit regeneration and growth of standing trees. Considering all ownerships, the average growth per acre is only 51 percent of the potential, about 38 cubic feet per acre per year out of a capacity of 74 cubic feet.

NEW GROWTH OF SAWTIMBER UP 50 PERCENT SINCE 1952



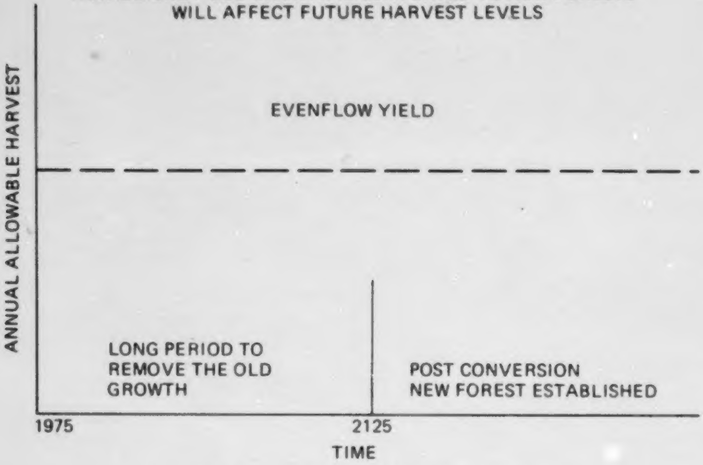
- The increase in net growth has a corresponding increase in the amount of cut timber. However, maintenance of long-term supplies means that harvest must not exceed growth. About one-fourth more softwood sawtimber and about one-fifth more hardwood are grown in the East than are cut. In the West, removals are almost twice the growth.



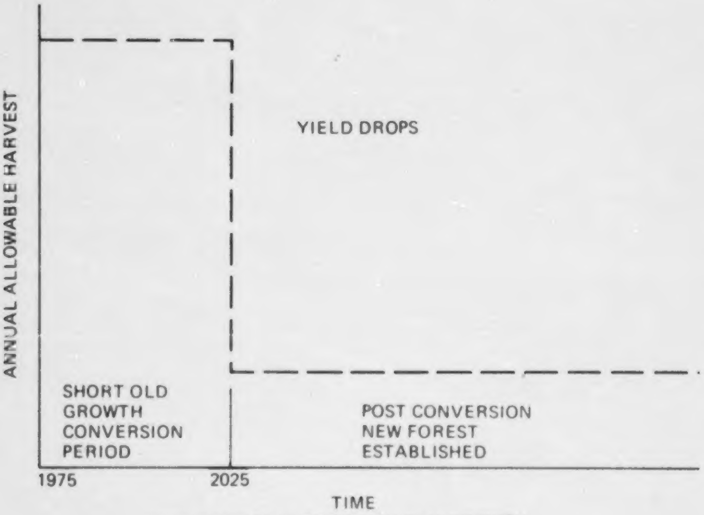
GROWTH EXCEEDS HARVEST EXCEPT IN THE WEST

- National Forest old growth softwood sawtimber stands, with high mortality and slow growth, are slowly harvested under a management concept called "evenflow." This concept schedules old growth stands for gradual harvest and converts the land to new stands over a long time period. The annual yield thus remains the same during and after the conversion period. If old trees are harvested too rapidly, the yield will eventually drop because new growth trees are not yet at the cutting stage, and the flow of timber is uneven.

HOW QUICKLY OLD GROWTH IS CONVERTED TO NEW FORESTS WILL AFFECT FUTURE HARVEST LEVELS



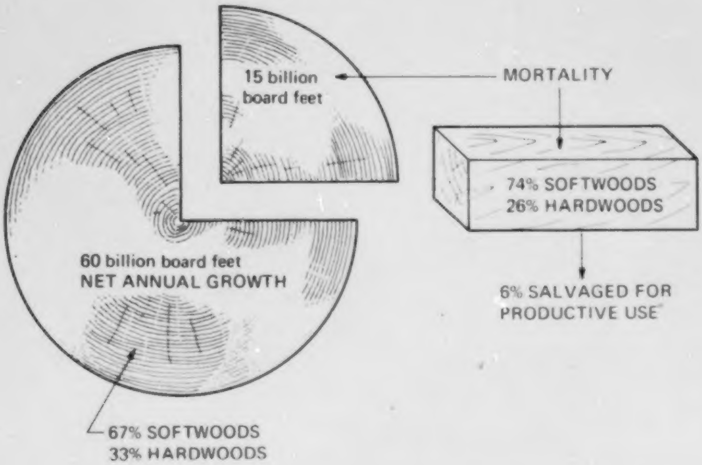
EVENFLOW: OLD GROWTH FORESTS ARE GRADUALLY CONVERTED TO NEW FORESTS OVER A LONG TIME BY REMOVING AN ANNUAL VOLUME (YIELD) EQUAL TO THAT WHICH IN THE FUTURE CAN BE HARVESTED FROM THE REPLACEMENT FORESTS.



YIELD DROPS IF TOO MUCH OLD GROWTH IS REMOVED TOO QUICKLY BECAUSE THE REPLACEMENT FOREST HAS NOT BEEN GROWING LONG ENOUGH TO PRODUCE ENOUGH HARVESTABLE TREES TO SUSTAIN THE PREVIOUS ANNUAL HARVEST LEVEL.

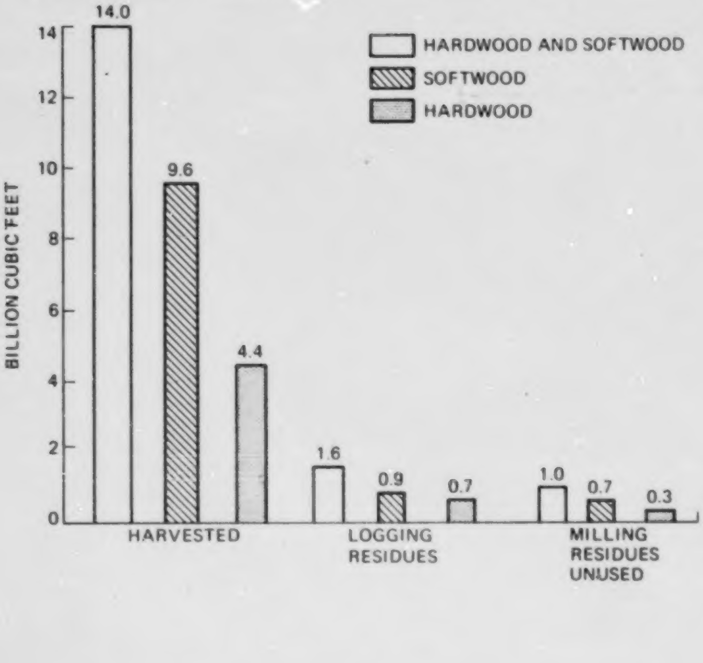
- Insects, diseases, fire, and other forest enemies destroy about one-fourth of the net annual sawtimber growth. This loss amounts to 15.3 billion board feet (or about 2.6 billion cubic feet in the sawlog portion of sawtimber trees), with mortality losses greatest for softwoods. Loggers salvage about 7 percent of the softwood mortality and about 3 percent of the hardwood mortality.

SAWTIMBER GROWTH VERSUS MORTALITY


15 billion
board feet
MORTALITY
74% SOFTWOODS
26% HARDWOODS
6% SALVAGED FOR
PRODUCTIVE USE
60 billion board feet
NET ANNUAL GROWTH
67% SOFTWOODS
33% HARDWOODS

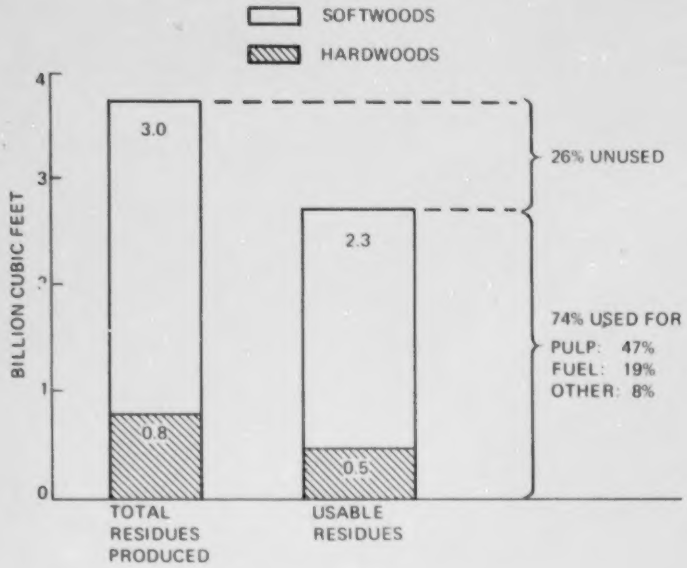
- A large amount of the wood from trees cut each year in the United States is left in the forests. In 1970 this amounted to 1.6 billion cubic feet or about 11 percent of the total volume of wood removed from the forests, more than half softwood. Although most of this residue is potentially useful for a variety of products, it is not presently considered economical to remove it. It is not all wasted, however, as nutrients from decomposing wood are returned to the soil to be used by new vegetation. An additional billion cubic feet (7 percent) is milling residue, not suitable for or practical to convert to other uses.

LOGGING AND MILLING RESIDUES. ALMOST ONE-FIFTH OF WOOD HARVESTED IS NOT CONVERTED INTO PRODUCTS



- About 3.8 billion cubic feet of the wood processed in 1970 by primary manufacturers became residue slabs, edgings, sawdust, veneer cores, and other coarse material. However, almost three-quarters of the volume of such byproducts was used to make other products. Economic and technological developments continue to favor this trend toward closer utilization of wood.

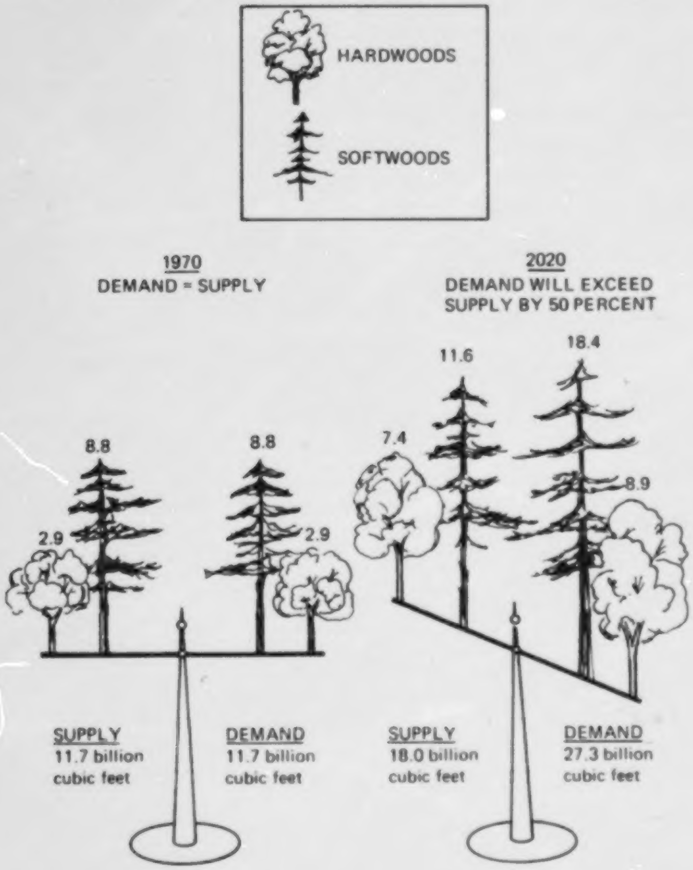
ALMOST THREE-FOURTHS OF MILLING RESIDUE IS CONVERTED TO PULP, FUEL, OR OTHER USEFUL PRODUCTS



- Future timber supplies depend upon the type and intensity of forest management, area of land available for commercial timber production, and general level of national economic activity. Assuming that recent levels of management continue, cutting practices and policies are similar to those of recent years, the timberland base shrinks slightly, and relative prices for timber follow 1970 price levels, then supply and demand for wood would probably increase. Demand, however, will greatly outstrip supply in 2020. The most critical shortages will be for softwood sawtimber, for which demand will exceed supply by almost 50 percent.

A significant rise in wood product prices over 1970 levels will bring demands closer to anticipated supplies. However, higher prices could also bring some adverse social and environmental consequences. For example, rising prices for timber can reduce housing starts, and force wood demand to shift toward competing materials such as metals, plastics, and concrete. These materials are produced from nonrenewable resources that require far more energy to produce than do the wood products.

SUPPLY/DEMAND RELATIONSHIP FOR ROUNDWOOD PRODUCED FROM DOMESTIC TIMBERLANDS (BILLION CUBIC FEET)



- The U.S. Department of Agriculture, Forest Service, has prepared alternative long-range programs for managing the National Forests, as directed by the Renewable Resources Planning Act of 1974. One alternative has been recommended by the President to Congress. Part of this program involves timber resources, and has a goal to increase timber supplies and quality to the point where benefits are commensurate with costs. If this program is followed, the nation could almost meet its timber needs in the year 2020 and do so in a sound environmental manner. The program contemplated by the Forest Service would maximize net benefits and result in a significant lowering of the long-term price trends. Timber supplies would be large enough to stabilize prices of softwood sawtimber and certain high-quality hardwoods; imports would be reduced, thus contributing to a national self sufficiency.

RECOMMENDED TARGETS FOR ROUNDWOOD PRODUCTION
(BILLION CUBIC FEET)

TIMBERLAND OWNER	PRODUCED	TARGET PRODUCTION	
	1970	1980	2020
NATIONAL FOREST	2.0	2.9	3.7
OTHER PUBLIC	0.8	1.2	1.9
FOREST INDUSTRY	3.4	3.4	4.6
OTHER PRIVATE	5.9	8.8	15.9
TOTAL PRODUCTION FROM U.S. FORESTS	12.1	16.3	26.1
EXPECTED DEMAND[a] ON U.S. FORESTS			27.3
TOTAL U.S. DEMAND[a]			27.8

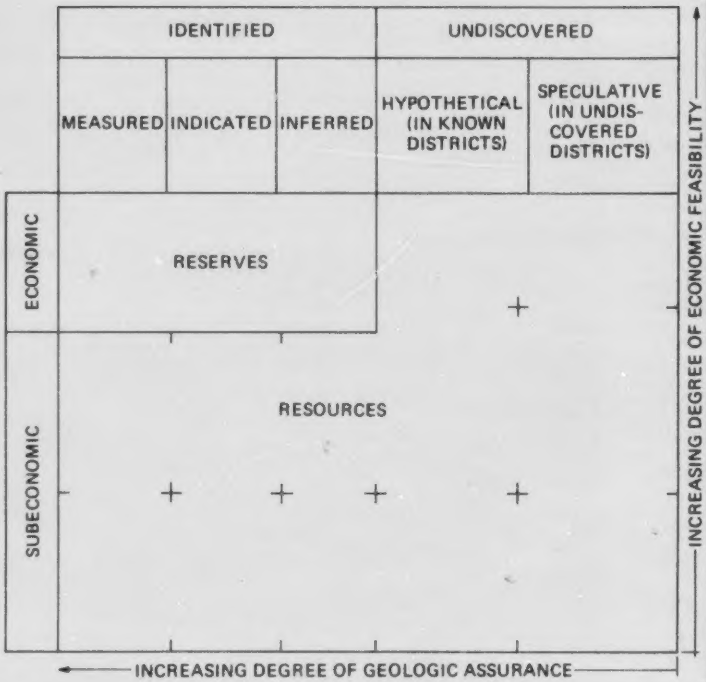
[a] Demand at 1970 relative prices.

MINERALS

Materials are extracted from the environment, to be processed, used, and finally returned to the environment. In an open-ended materials system, wastes are discarded as various forms of pollution. In a closed materials system, wastes are recycled as much as possible, leaving minimal amounts to be discharged into the environment.

- There are several categories that classify the geologic and economic availability of a given mineral deposit.

CLASSIFICATION OF MINERAL RESOURCES



TOTAL RESOURCES

IDENTIFIED

UNDISCOVERED

MEASURED

INDICATED

INFERRED

HYPOTHETICAL (IN KNOWN DISTRICTS)

SPECULATIVE (IN UNDISCOVERED DISTRICTS)

ECONOMIC

RESERVES

SUBECONOMIC

RESOURCES

INCREASING DEGREE OF GEOLOGIC ASSURANCE

INCREASING DEGREE OF ECONOMIC FEASIBILITY

Speculative resources. Undiscovered resources that may occur either in known types of deposits in a favorable geologic setting where no discoveries have been made, or in as yet unknown types of deposits that remain to be recognized. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as Reserves or Identified-Subeconomic resources.

Resource. A mineral resource concentration of naturally occurring solid, liquid, or gaseous materials in or on the Earth's crust in such form that economic extraction of a commodity is currently or potentially feasible.

Identified Resources. Specific bodies of mineral-bearing material whose location, quality and quantity are known from geologic evidence supported by engineering measurements with respect to the demonstrated category.

Undiscovered Resources. Unspecified bodies of mineral-bearing material surmised to exist on the basis of broad geologic knowledge and theory.

Reserve. That portion of the identified resource from which a usable mineral and energy commodity can be economically and legally extracted at the time of determination. The term ore is used for reserves of some minerals.

Definitions for measured, indicated, and inferred are applicable to both Reserve and Identified-Subeconomic resource components.[a]

Measured. Reserves or resources for which tonnage is computed from dimensions revealed in outcrops, trenches, workings, and drill holes and for which the grade is computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, and mineral content are well established. The computed tonnage and grade are judged to be accurate within limits which are stated, and no such limit is judged to be different from the computed tonnage or grade by more than 20 percent.

Indicated. Reserves or resources for which tonnage and grade are computed partly from specific measurements, samples, or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade established throughout.

Inferred. Reserves or resources for which quantitative estimates are based largely on broad knowledge of the geologic character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition, of which there is geologic evidence; this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geologic evidence of their presence. Estimates of inferred reserves or resources should include a statement of the specific limits within which the inferred material may lie.

Identified-Subeconomic. Resources that are not Reserves, but may become so as a result of changes in economic and legal conditions.

Hypothetical resources. Undiscovered resources that may reasonably be expected to exist in a known mining district under known geologic conditions. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as a Reserve or Identified-Subeconomic resource.

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[a] The terms proved, probable, and possible (used by the industry and economic evaluations of ore in specific deposits or districts) commonly have been used loosely and interchangeably with the terms "measured", "indicated", or "inferred" (used by the Department of the Interior mainly for regional or national estimates). "Proved" and "measured" are essentially synonymous. "Probable" and "possible", however, are not synonymous with "indicated" and "inferred". "Probable" and "possible" describe estimates of partly sampled deposits—in some definitions, for example, "probable" is used to describe deposits sampled on two or three sides, and "possible" for deposits sampled only on one side. In the Bureau-Survey definitions, both would be described by the term "indicated".

Source: "Principles of the Mineral Resource Classification System of the U.S. Bureau of Mines and U.S. Geological Survey," Geological Survey Bulletin 1450–A (1976), pp. A2–A3.

- Scarcity of a mineral does not often happen because the Earth's supply has been depleted. The amount of minerals available at any one time depends on the composition of the Earth's crust, exploration, technology of extraction and refining, price, and government policy and regulation. There is always a time lag between discovery and production.

  Mineral reserves are only a small part of the total mineral resources found in the Earth's crust. Reserves are the identified portion of a total mineral resource which is usable and which can be economically and legally extracted at the time of determination. The term ore is used for reserves of some minerals.

  Reserves, therefore, are not static. Projections of supply change frequently to take into account developments in technology, new discoveries (often unreported), changes in price, or governmental policy changes.

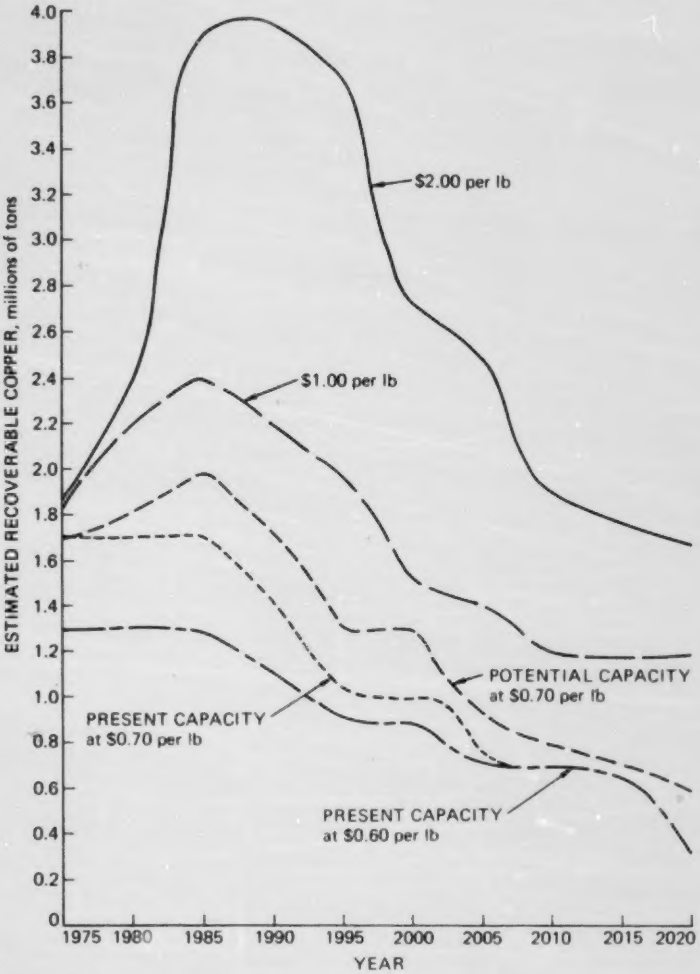
CHANGES IN U.S. RESERVES AND PRODUCTION OF SELECTED MINERALS, 1950–1975 (IN MILLIONS OF SHORT TONS BY METAL CONTENT)

	RESERVES 1950	PRODUCTION 1950-1971	RESERVES 1971	PRODUCTION 1972-1975	RESERVES 1975
BAUXITE	11	10	13	2	10
COPPER	25	25	81	6	90
IRON ORE	3000	1182	2000	223	4000
LEAD	7	8	36	3	56
ZINC	16	12	30	2	30

Source: U.S. Department of the Interior, Bureau of Mines, *Mineral Facts and Problems, 1950 and 1970 Annual Commodity Statements* for 1971, 1972, and 1976.

- As the price of a metal increases in relation to the cost of extraction, it becomes economically feasible to recover larger amounts of it. Thus, supply is a function of price.

PRESENT AND POTENTIAL ANNUAL PRODUCTION CAPABILITIES FROM U.S. DOMESTIC RESOURCES, BASED ON THE PRICE OF COPPER



Source: U.S. Department of the Interior, Bureau of Mines.

- In many cases (such as copper) rather than "running out" of a mineral, increasingly lower grades of ores are mined, for which there is more surface disturbed and more energy used. It is very expensive to find metallurgical methods to extract needed metals and minerals from complex formations that previously were not used for mineral value. Thus, we are "running out" of cheap high-grade deposits of minerals and not the minerals themselves.

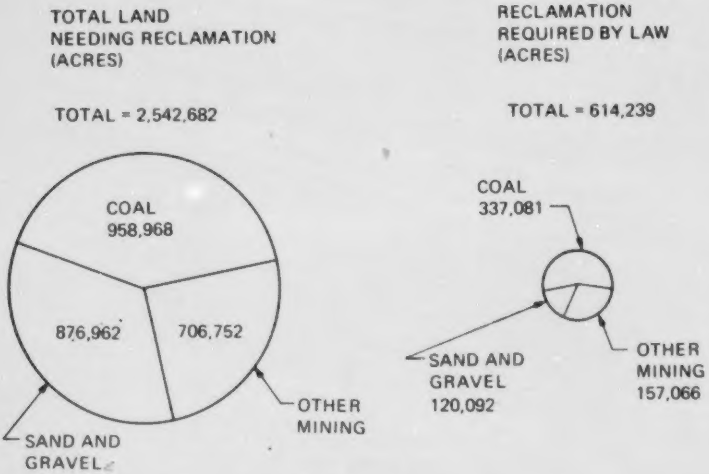
COPPER ORE GRADE HISTORY: 1900–1973

YEAR	AVERAGE GRADE OF ORE MINED (PERCENT COPPER)
1900	4.00
1910	1.88
1920	1.63
1930	1.43
1940	1.20
1950	0.89
1955	0.83
1960	0.73
1965	0.70
1970	0.60
1973	0.53

Source: Wimpfen, Sheldon P., and Knoerr, Alvin W., "World Resources vs Copper and Aluminum Demand to the Year 2000," prepared for presentation at the Eighth World Mining Congress, Lima, Peru, Nov. 3–8, 1974. U.S. Department of the Interior, Bureau of Mines, *Copper*, a preprint from Bulletin 667, (Washington, D.C.: U.S. Government Printing Office, 1976).

- The total amount of land in need of reclamation is four times the amount of land for which reclamation is required by present law.

STATUS OF LAND DISTURBED BY SURFACE MINING
IN THE UNITED STATES AS OF JANUARY 1, 1974



Source: Based on information supplied by Soil Conservation Service State conservationists.

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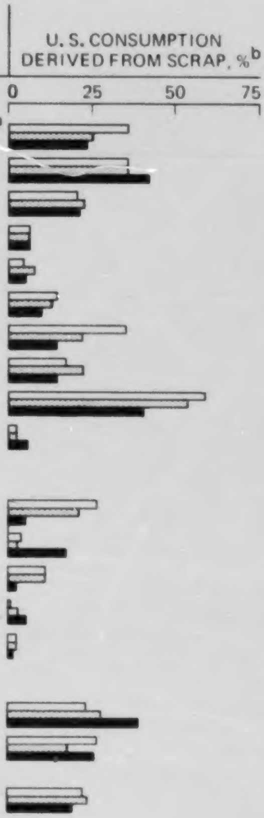
- Although there is more interest in recycling scrap metals, technological and market constraints hamper recycled scrap from playing an important role in supplying our materials needs.

OLD SCRAP RECLAIMED IN THE UNITED STATES: 1973–1975

	1973 SHORT TONS	1974 SHORT TONS	1975 SHORT TONS
MAJOR			
IRON	46,400,000[a]	32,000,000[a]	25,300,000[a]
LEAD	506,000	508,000	497,000
COPPER	473,000	483,000	353,000
ALUMINUM	250,000	265,000	304,000
ZINC	81,000	106,000	49,000
CHROMIUM	60,000	54,000	38,000
NICKEL	73,900	34,000	35,000
TIN	13,000	12,900	8,400
ANTIMONY	17,600	22,400	16,600
MAGNESIUM	2,700	4,500	6,000
MINOR			
MERCURY	494	342	319
TUNGSTEN	250	250	375
TANTALUM	62	100	25
COBALT	65	240	130
SELENIUM	15	15	5
PRECIOUS			
SILVER	1,049	1,893	1,498
GOLD	82	21	31
PLATINUM GROUP	10	12	10



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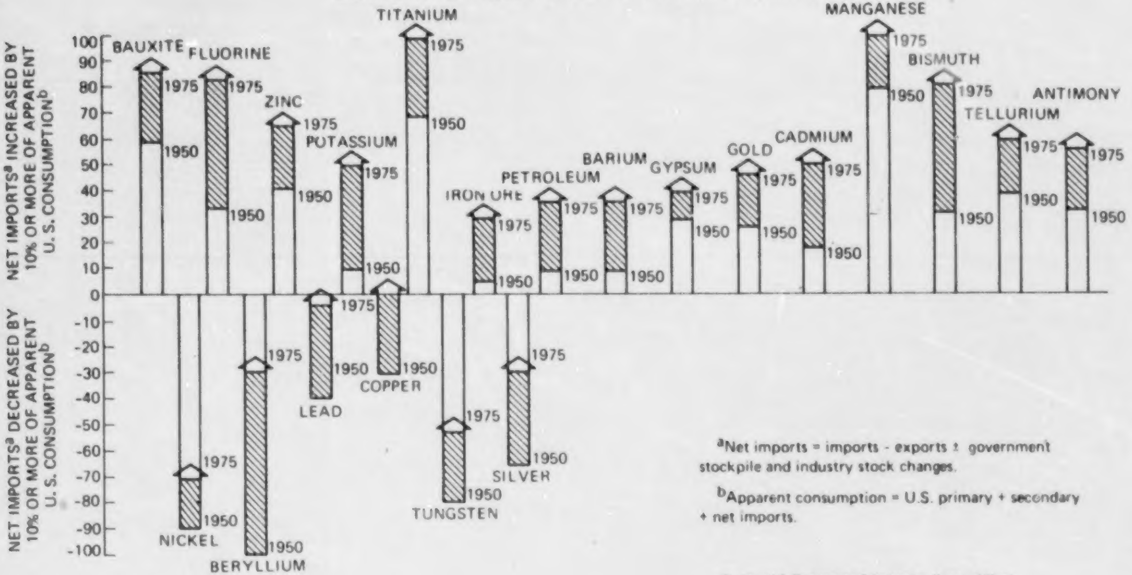
[a] Includes exports.

[b] Apparent consumption = U.S. primary + secondary production + imports - exports + government stockpile and industry stock changes.

Source: U. S. Department of the Interior, Bureau of Mines.

- **Between 1950 and 1970 we increased our imports by 10 percent or more in 15 commodities, and reduced our reliance on imports by 10 percent or more in six other minerals.**

SIGNIFICANT CHANGES IN IMPORTATION LEVEL: 1950–1975



[a] Net imports = imports - exports ± government stockpile and industry stock changes.

[b] Apparent consumption = U.S. primary + secondary + net imports.

Source: U.S. Department of the Interior, Bureau of Mines

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$$C_s = \frac{C_1Q_1 + C_2Q_2 + \ldots + C_nQ_n}{Q_1 + Q_2 + \ldots + Q_n}$$

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APPENDIX A. ORGANIZATION AND STAFF OF THE COUNCIL ON ENVIRONMENTAL QUALITY

THE COUNCIL

Russell W. Peterson was sworn in as Chairman of the Council on November 30, 1973. From 1969 to 1973 he was Governor of Delaware. From 1942 to 1968, Chairman Peterson was with E. I. du Pont de Nemours & Company. In 1971 he was named Conservationist of the Year by the National Wildlife Federation and given the Gold Medal Award by the World Wildlife Fund.

John A. Busterud and Dr. Beatrice E. Willard are the other Members of the Council, both appointed in 1972. Mr. Busterud was Deputy Assistant Secretary of Defense for Environmental Quality from 1971 to 1972. Prior to this, he practiced law with a San Francisco firm specializing in conservation and antitrust law. He was a member of the Assembly in the California legislature.

Dr. Willard, an ecologist, is former President of the Thorne Ecological Institute of Boulder, an ecology center for industrial and government decisionmakers. She has served as Secretary of the Colorado Air Pollution Control Commission. She has been a professor of biology at the University of Colorado and is the author of books on alpine ecosystems.

THE COUNCIL'S STAFF

The Council's staff is primarily responsible for developing policy proposals through legislation, special reports, task forces, and other means. It also assists in the coordination of federal environmental policy. The staff is responsible for review and evaluation of federal activities which have a potential effect on the environment, and for policy development relating to such activities. Steven D. Jellinek is Staff Director and William Matuszeski is Assistant Staff Director. Malcolm F. Baldwin, Paul F. Bente, Jr., Edwin H. Clark, Charles Eddy, Barry R. Flamm, and Warren R. Muir are Senior Staff Members. Staff Members are Gerald L. Brubaker, John A. Davidson, Katherine B. Gillman, Warren T. Greenleaf, Jacques G. Gros, Lawrence W. Hill, Kay Jones, Michael F. Kane, Joyce M. Kelly, Marilyn W. Klein, Sally Mallison, Mary Jane S. Markley, Bernard N. Merrill, C. Donald Meyers, Sheila A. Mulvihill, James J. Reisa, Jr., Robert B. Smythe, E. Zell Steever, Marion P. Suter, D. W. Scholte Ubing, and Ermine van der Wyk.

GENERAL COUNSEL

The General Counsel's Office is responsible for review of legislative and regulatory matters coming before the Council, specifically with regard to the interpretation and implementation of the National Environmental Policy Act. Gary L. Widman, General Counsel to the Council, is assisted by Richard E. Gutting, Constance K. Lundberg, David Tundermann, and Kenneth S. Weiner.

ADVISORS

Technical advisors on the Council's staff provide expertise in the areas of science and international affairs. They are Lee M. Talbot, Assistant to the Chairman for International and Scientific Affairs, and George M. Bennsky, Senior Staff Member for International Activities, who are on detail from the Department of State. Gerard A. Bertrand and Howard P. Brokaw are assistants to Dr. Talbot, and James J. Mandros, on detail from the U.S. Information Agency, is an assistant to Mr. Bennsky.

ADMINISTRATIVE STAFF

John R. Fogarty is Public Information Officer, Willis G. Savage is Administrative Officer, and Bernice Carney is Assistant Administrative Officer.

SUPPORTIVE STAFF

Florence L. Broussard, Ruth W. Nefflen, and Marjorie D. Armstrong are executive assistants to the Chairman, Mr. Busterud, and Dr. Willard, respectively. Other staff members are: Eugene H. Able, Julia Alessio, Margaret C. Battle, Janet L. Bearden, Vicki L. Boyd, Yvonne R. Countee, Odelia L. Doggette, Margaret M. Gugino, Anna M. Klocke, Muriel L. Montgomery, Janet A. Peck, Helen Z. Rebholz, Stewart V. Redfield, Barbara E. Sergeant, Debbie Streeter, William Whitehouse, M. Gayle Wilkins, and Norma L. Williams.

INTERNS

Dean R. Benson, George Washington University Law School; Michael C. Blumm, George Washington University Law School; Richard P. Bozof, M.D., Boalt Hall Law School, University of California at Berkeley; Bruce B. Duncan, School of Medicine, The John Hopkins University; Eric Erdheim, George Washington University Law School; Elisabeth Evans, University of Arizona; David J. Goldhill, Horace Mann High School, New York City; Mark A. Greenwood, University of Michigan Law School; Rodd Hamman, New York University Law School; Alexis Hoskins, University of California at Riverside; Robert King, Kansas State University; Julia E. Lee, George Washington University; James W. Margolis, The Woodrow Wilson School, Princeton University; Peter H. May, Department of City and Regional Planning, Cornell University; Elizabeth D. Mullin, Mount Holyoke College; Ann E. Prezyna, George Washington University Law School; Kathryn L. Russell, Georgetown University Law Center; Jana Singer, Dartmouth College; Marna Skaar, Wellesley College; Ronald G. Strickland, School of Foreign Service, Georgetown University; Mary Kuni Suzuki, Boston University Law School and Harvard School of Design; Ellen Theg, Wellesley College; Jeffrey B. Tschirley, Colorado State University.

APPENDIX B. CEQ STUDIES

A considerable portion of the work of the Council on Environmental Quality is directed to the preparation of studies and analyses by the staff and by others under contract. Often the Council jointly funds such studies with other federal agencies. Nearly all of the work is published for use by the public. Major reports are available through the U.S. Government Printing Office; more technical analyses may be obtained from the National Technical Information Service of the Department of Commerce.* A limited number of copies is also available from the Council. What follows is a brief description of major reports made available during the past year as well as a description of a number of studies currently underway.

ENVIRONMENTAL QUALITY INDICATORS, 1976
(To be available from GPO)
COMPENDIUM OF ENVIRONMENTAL STATISTICS, 1976
(To be available from GPO)

During the 6 years since enactment of the National Environmental Policy Act of 1969, Americans have become considerably more sophisticated and knowledgeable about environmental issues. Having witnessed the reported progress and problems of our national efforts to protect the environment and manage natural resources, the public has become more cognizant of the factors that affect the success of these efforts, as well as their social and economic implications.

Paralleling this growth in public awareness, there has been a marked increase in the kinds and amounts of data that are being collected to characterize the important environmental issues and their causes. Properly evaluated and disseminated, this infomation can help to ensure that important judgments affecting environmental protection and natural resources are made on an informed basis.

The environment is measurable in many different terms—scientific, technological, demographic, economic, and social. Many of the data are publicly available, but quite diffuse. For the citizen, public decisionmaker, and environmental specialist, it is often difficult to learn what authoritative indicators and statistics are available on a given topic, and where and how to obtain them efficiently. It is often even more difficult to synthesize, interpret, and apply these data to develop informed judgments about environmental issues.

During the past 5 years, CEQ has developed an array of environmental indicators and statistical series, conducted studies on environmental issues, conditions, and trends, and published special and annual reports on these topics. Through such activities, and through the collaboration and independent efforts of other federal agencies, it is now feasible to begin the regular publication of two new periodic federal documents which will provide a reasonably comprehensive and authoritative overview of environmental conditions and trends through the use of graphic indicators and statistical presentations.

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*GPO-Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402; NTIS-National Technical Information Service, U.S. Department of Commerce, Springfield, Va. 22151.

Environmental Quality Indicators, 1976 can be described as a national "briefing" document that will provide policymakers and the general public with a lucid, graphic overview of important environmental issues, conditions, and trends. The information will be presented mostly in charts, graphs, diagrams, and maps, with accompanying text for explanation and emphasis. The primary aim of this document is to bring together a considerable amount of environmental information in a format that is comprehensive in its coverage of important environmental topics, systematic in its treatment of them, and revealing of the interrelationships between environmental conditions and the social and economic factors that affect them.

The Compendium of Environmental Statistics, 1976 will be a reasonably comprehensive collection of statistical information on important environmental issues. It will cover the same subject areas as *Environmental Quality Indicators,* plus additional topics, but in greater depth. The data will be presented in tables with accompanying annotations, references, and sources. The compendium will provide data for the use of researchers, analysts, and others in the environmental field who need a detailed but ready compendium of statistical information. The study is being sponsored by CEQ, Interior, and EPA, and is being carried out by CEQ and Stanford Research Institute.

Both publications are expected to be released to the public in early 1977 and to be updated and published annually or biannually thereafter.

OIL SPILL TRENDS
(To be available from NTIS)

It has been difficult in past years to evaluate national trends in accidental oil spills because the data were collected when civil penalties were not as severe and the reporting system not as sophisticated as it is today. By estimating the year-by-year spill reporting efficiency, however, it has become possible to examine such trends.

With the cooperation of the Coast Guard, CEQ and EPA are sponsoring a study of recent and projected spill trends for a number of selected oil-handling facilities. The study is being undertaken by GKY and Associates. Since 1972, there has been a significant decrease in the amount of oil spilled at petroleum storage facilities, and minor decreases from refineries, offshore wells, vessels, and pipelines. The decrease in amount of oil spilled is attributed to the implementation of spill prevention plans and to improved technology of spill prevention and containment. However, spills at onshore wells have significantly increased. The increase from mainland wells is believed to be partly the result of reactivating old, marginally productive wells and of using old equipment. Increased oil prices have stimulated such actions.

Approximately 49 percent of all spills involves volumes less than 10 gallons; 75 percent is below 100 gallons; and only 1.2 percent of the spills is larger than 10,000 gallons. However, the large spills account for more than 90 percent of the oil spilled.

Final results of this study are expected to be released in fall 1976.

IMPACTS OF GOVERNMENTAL RESTRICTIONS ON PRODUCTION AND USE OF CHEMICALS

As the environmental implications of hazardous chemicals become better known, many more decisions are being made about possible restrictions upon their production, distribution, and use. This study, jointly sponsored by CEQ and EPA and conducted by the Center for Policy Alternatives at the Massachusetts Institute of Technology, attempts to develop a methodology for assessing the total costs and benefits to society of such decisions.

Based upon the experience in applying the assessment methodology to several case studies,

- Vinyl chloride industrial
- Vinyl chloride food additive
- Industrial mercury discharges to water
- Mercury seed treatment
- Pharmaceuticals containing mercury
- Hexachlorophene
- PCBs
- Benzene

a user's guide and recommendations on its use will be prepared.

Although both costs and benefits are assessed, there are some categories of each which cannot be put into dollar terms or quantified at all. Thus, the ultimate decision on any restriction implies certain value judgments on the part of the decisionmaker.

The study should be completed by fall 1976.

FEDERAL TAXES AND LAND USE
(To be available from GPO and The Urban Institute)

This study is being sponsored by CEQ and the National Science Foundation (NSF) and is being carried out by The Urban Institute. Various ways in which federal tax policies influence factors such as urban development patterns, land investment decisions, housing choices, and residential location are being studied. Federal income and state tax laws are being examined to see how tax rates, deductions (e.g., mortgage interest and property taxes), depreciation schedules, valuation procedures, capital gains treatment, and other major provisions influence land use decisions by taxpayers. The study compares, for example, home ownership over time, among cities, and between the United States and Canada to estimate the impacts of income tax subsidies on home ownership rates across all income levels.

Various methods are used to determine the influence of tax subsidies on the type, location, and pattern of new housing construction. The analyses conclude that the tax structure has stimulated the construction of single family homes in the suburbs and discouraged the preservation of central city housing. The single family housing subsidy alone is estimated to have increased by 30 to 40 percent the amount of land used for housing.

The study also analyzes the impact of income, capital gains, and estate taxes on the rate and timing with which farmland and other open space is sold and developed. Partially based on a study of the land market in the Baltimore area, the most important determinants of when such open land is converted to development are the age and family situation of the original owner—most land is sold at retirement or death. All existing tax laws reinforce the tendency for such life cycle considerations to have a pre-eminent influence.

The study will be available in winter 1977.

METROPOLITAN AREA DEVELOPMENT PATTERNS
(To be available from GPO)

The first study in this series, *The Costs of Sprawl*, focused on development patterns at the neighborhood and community level. This follow-on study is being sponsored by CEQ in association with the Department of Housing and Urban Development, Department of Transportation, the National Science Foundation, the Environmental Protection Agency, and the Federal Energy

Administration, and is being undertaken by The Urban Institute. The study analyzes the environmental, economic, natural resource, and social impacts of alternative land use patterns in metropolitan areas. It analyzes over 100 actual U.S. metropolitan areas to develop statistical measures of development patterns, and to estimate some of the economic effects of those patterns. A more intense analysis of 15 metropolitan areas is being used to provide detailed information on the interrelationship between neighborhood and metropolitan development patterns, and how each affects such factors as travel (by mode and purpose), resource consumption, and various environmental, economic, and social factors.

Air pollution modeling is also being used to estimate the impact of development patterns on air pollution concentrations in residential areas.

The study will analyze (primarily by reviewing other research) how government decisions and actions help to determine what type of development pattern occurs and various effects associated with alternative development patterns.

The results of the study will be presented in a series of reports for both general and technical audiences.

The study will be completed in early 1977.

ENERGY AND THE COASTAL ENVIRONMENT
(To be available from GPO)

Coastal lands and waters provide food, living space, and recreation; sites for industry, ports and waterways, airports, and highways; habitat for wildlife; and a sink for wastes. Aside from these uses, the coastal zone must also accommodate energy facilities, such as the development of oil and gas from new, previously untapped areas of the outer continental shelf (OCS). Other new energy systems in the coastal zone include deepwater ports for supertankers and marine terminals and shoreside facilities for liquefied natural gas.

This study analyzes the probable impacts of these new energy systems on the coastal zone and where and how energy development can be managed with most advantage and least cost to coastal communities and the natural environment.

The first report on this study considers the impacts of oil offshore, sources of oil spills, likelihood of occurrence, and their ecological effects.

The report examines U.S. energy demand and supply from the viewpoint of OCS oil and gas, then explores protection measures against oil pollution or other damage from OCS activities.

Onshore effects of oil and gas development on air, water, scenery, as well as land, are discussed. Social and economic impacts on jobs, incomes, housing, community services, and structures are noted.

The study will be available in fall 1976.

WESTERN REGIONAL ENERGY DEVELOPMENT STUDY: ECONOMICS
(To be available from NTIS)
WESTERN REGIONAL ENERGY DEVELOPMENT STUDY: SOCIOECONOMIC IMPACTS
(To be available from GPO)

The western region of the United States contains an abundance of energy resources, including coal, oil, natural gas, oil shale, tight gas sands, tar sands, uranium, and geothermal, all of which present significant choices for development. In considering these choices, environmental, economic, and social tradeoffs must be examined. A study program to investigate these tradeoffs is being sponsored by an interagency committee under the aegis of CEQ.

The first report, "A Western Regional Energy Development Study: Primary Environmental Impacts," was discussed in last year's Annual Report.

The second phase of the study, under contract to Stanford Research Institute, examines the economics of 38 energy resource development scenarios. This supply analysis looks at capital investments and operating costs for extracting, converting, and transporting all forms of energy. These data have been placed in a computer model along with a projection of U.S. energy demand to the year 2000.

Results of this study will be available in winter 1976.

In the third phase, Denver Research Institute is examining the socioeconomic and secondary environmental impacts of western energy development. The first part of this study develops and tests alternative assessment methods for evaluating these impacts in the oil shale region of Colorado. The second part of this study refines and tests the selected method in selected locations to ascertain those socioeconomic impact variables most critical to determining growth consequences of energy-related development and to demonstrate the general applicability of the method. The study also analyzes related policy issues and the effectiveness of various measures to mitigate the impacts. Economic and social impacts include employment, income, population, social characteristics and housing, private investment costs, public costs and revenues, and institutions for planning and growth management.

Results of this study will be available in summer 1977.

ENVIRONMENT AND CONSERVATION IN NON-NUCLEAR ENERGY RESEARCH AND DEVELOPMENT

In the past, neither energy conservation nor environmental considerations were significant parts of public or private energy research, development, and demonstration (RD&D). The emphasis was on developing and improving energy supply technologies.

However, in 1974, Congress and the Executive Branch made fundamental changes in the approach and structure of federal energy RD&D activities. The Arab oil embargo of the previous winter forced major changes in government policy, including RD&D, which had focused heavily on nuclear power. The Non-nuclear Energy Research and Development Act of 1974 provided the framework for a balanced non-nuclear energy program and showed particular concern for environmental protection and energy conservation.

In Section 11 of the Non-nuclear Act the Congress gave to CEQ new and unique responsibilities with respect to the non-nuclear energy RD&D programs:

- To conduct a continuing analysis of the adequacy of attention to energy conservation methods, the adequacy of attention to environmental protection, and the environmental consequences of the application of energy technologies.
- To prepare reports to the President, the Congress, and the ERDA Administrator on the Council's findings.
- To set forth in the President's annual environmental policy report the Council's findings on probable environmental consequences of trends in the development and application of energy technologies.
- To hold annual public hearings on the conduct of energy research and development.

The first series of public hearings was held in September 1975 in Washington, D.C., Los Angeles, and Detroit. A report on the hearings was published in January 1976.

The first major report of the results of the Council's continuing analysis of adequacy of attention to environment and conservation will be published in fall 1976. This report will evaluate the progress to date of ERDA and other agencies in building environment and conservation into their programs. It will point out what the Council believes to be the major problems in adequately addressing these two areas in the broader context of the federal energy RD&D effort.

ENVIRONMENTAL IMPACT STATEMENTS (Available from CEQ)

This CEQ staff report, "Environmental Impact Statements: An Analysis of Six Years' Experience of Seventy Federal Agencies," presents the results of a year-long review in 1975 of the experiences of federal agencies in implementing Section 102(2)(C) of the National Environmental Policy Act of 1969. Based on questionnaires sent to all federal agencies and state governments, on meetings with federal agencies with major NEPA responsibilities and on CEQ staff evaluations, the report examines the use and effect of the impact statement process in federal planning and decisionmaking, time required to complete the process, the effects of impact statement litigation on project delay, content and quality of impact statements and the comment process, among other topics. The report also shows that the number of draft impact statements filed in 1975 decreased slightly over the previous years, but predicts that the number is expected to increase somewhat in 1976 as the scope of the process continues to expand to new agencies such as the Federal Energy Administration and the Consumer Product Safety Commission.

Among the major recommendations included in the report are those urging improved agency training programs on NEPA-related issues; definition of the use of program environmental impact statements and the appropriate scope of their analysis; increased use of environmental assessment procedures to determine whether an impact statement is required; exploration of standards defining the scope of the "human environment," including reasonable limits for analysis of social, economic, and all secondary impacts.

1976 ASSESSMENT OF THE MACROECONOMIC IMPACTS OF FEDERAL POLLUTION CONTROL PROGRAMS (Available from CEQ and NTIS)

This report updates, by Chase Econometrics Associates, Inc., previous studies completed for CEQ and EPA assessing the impacts of air and water pollution abatement expenditures on such macroeconomic variables as economic growth, employment, inflation, and interest rates. The analysis covers the impact of the actual expenditures made from 1970 through 1975 as well as projected expenditures from 1975 through 1983. All cost estimates correspond to CEQ's definition of "incremental" abatement costs, and are consistent with the cost estimates given in the 1975 Annual Report. Some of the principal conclusions of the study are given below.

Over the period 1970-1983, the Wholesale Price Index (WPI) is projected to rise 6.4 percent more, the Consumer Price Index (CPI) 5.1 percent more, and the implicit Gross National Product (GNP) deflator 3.9 percent more than they would have risen in the absence of pollution control expenditures. These values correspond to an average annual rate of increase of 0.5 percent for the WPI, 0.4 percent for the CPI, and 0.3 percent for the GNP deflator over this period.

The largest 1-year increases are projected to occur in 1977, with increases almost as large occurring in 1975 and 1976; during this 3-year peak period the WPI rises 2.4 percent more, the CPI rises 1.8 percent more, and the GNP deflator 1.3 percent more than they would be expected to increase without pollution abatement requirements.

Regarding the rate of economic growth, the Chase analysis indicates that the stimulus of increased expenditures for pollution control has raised the rate of economic growth above what it would otherwise have been through 1976; the maximum difference (in constant-dollar GNP) is 0.3 percent. In the latter half of the decade, however, lower levels of pollution control investment combined with a higher rate of inflation are projected to lead to a slower rate of economic growth. By 1983, real GNP is projected to be 2.0 percent below the baseline forecast.

In keeping with the pattern of overall economic growth, the unemployment rate is projected to be 0.3 percent lower in 1976 and 0.4 percent lower in 1977 than it otherwise would have been. However, it gradually rises to a level of 0.2 percent above the baseline forecast by 1983.

THE ENVIRONMENTAL CONTROL INDUSTRY: AN ANALYSIS OF CONDITIONS AND PROSPECTS FOR THE POLLUTION CONTROL EQUIPMENT INDUSTRY (Available from NTIS)

This report was prepared for a December 1975 CEQ-sponsored conference on the Environmental Equipment Industry—the aggregation of firms manufacturing air and water pollution control equipment and firms collecting solid wastes. The report analyzes the size, production, composition, and profitability of the industry, and projects the industry's rate of growth based on CEQ's estimates of future pollution abatement expenditures. The authors of the report, Kenneth Ch'uan'k'ai Leung and Jeffrey A. Klein, are Wall Street analysts specializing in firms producing pollution control equipment.

The study found that the pollution control equipment industry is represented by at least 600 participating firms (not counting the 10,000 waste collection companies), including over a dozen companies visibly identified as pollution-control-related, several divisions of much larger corporations, and numerous small firms. Profits in the industry have not grown as consistently as volume has expanded in the past because of cash flow problems, intense competition, insufficient operating experience, a growing involvement in relatively unprofitable construction, shortages of skilled manpower, the general problem of inflation, materials shortages, and lengthening project lead times.

The study concluded, however, that as the industry matures, profit margins are stabilizing and are likely to expand in the future. Increased familiarity with equipment and process applications should prevent errors in design and make more use of standard equipment; and escalation clauses for materials as well as labor are now commonly included in contracts. Greater customer emphasis on efficiency and long-range performance, rather than just price, is upgrading conditions in the marketplace. These factors should enable profit margins to move to more acceptable levels, which will stimulate industry participants to commit resources for capacity expansion. Improving return on investment for supplier and user alike should facilitate their access to public financial markets for working capital and project financing purposes.

In terms of sales, the study estimated that during 1974, total flange-to-flange equipment supplied by the air and water pollution control industry approximated $1.425 billion. Auxiliary equipment and erection business represented an additional $360 million. Based upon CEQ total pollution abatement expenditure projections, the pollution control industry could be called upon to provide equipment valued at $33.957 billion between 1974 and 1983 (in 1974 dollars). Related pollution abatement activities could total another $10.519 billion (in 1974 dollars) during this period.

APPENDIX C*

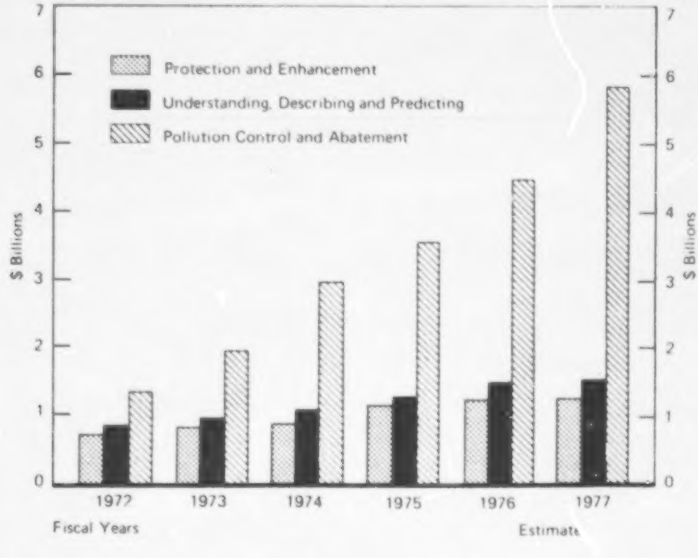
SPECIAL ANALYSIS Q

FEDERAL ENVIRONMENTAL PROGRAMS

INTRODUCTION

In 1977, 21 Federal agencies and departments expect to have outlays of $8.7 billion for environmental programs. This is an increase of 21% over 1976 Federal outlays of $7.2 billion. Although covering a wide range of activities, Federal environmental programs are classified in three broad categories: pollution control and abatement; understanding, describing and predicting the environment; and environmental protection and enhancement activities. Chart Q–1 shows the trends in total Federal expenditures for each category from 1972–77. The following table depiets the relationship between budget authority and outlays in each category.[1]

Environmental Outlays, by Category, 1972–1977



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[1] Not included in this analysis is $245 million in lost Federal revenue resulting from the tax exempt status of interest income from pollution control bonds.

*Reprinted from Office of Management and Budget, *Special Analyses: Budget of the United States Government, Fiscal Year 1977* (Washington, D.C.: U.S. Government Printing Office, 1976) pp. 296–313

Table Q-1. BUDGET AUTHORITY AND OUTLAYS—FEDERAL ENVIRONMENT PROGRAMS (in millions of dollars)

Activities	1975 actual	1976 estimate	TQ estimate	1977 estimate
BUDGET AUTHORITY				
Protection and enhancement	1,248.2	1,300.9	296.9	1,381.4
Understanding, describing, and predicting	1,352.4	1,486.5	375.3	1,607.1
Pollution control and abatement	1,802.5	1,843.9	409.5	1,870.5
Construction grants[1]	7,810.4	173.2	16.0	174.2
Total	12,213.5	4,804.5	1,097.7	5,033.2
OUTLAYS				
Protection and enhancement	1,128.5	1,242.6	328.5	1,327.0
Understanding, describing, and predicting	1,296.4	1,467.5	382.9	1,524.8
Pollution control and abatement	1,510.3	1,992.8	486.5	1,910.1
Construction grants[1]	2,060.5	2,474.4	633.7	3,913.0
Total	5,995.7	7,177.3	1,831.6	8,674.9

[1] Includes but is not limited to grants under the Water Pollution Control Act Amendments of 1972 which provided $18 billion in contract authority to EPA. Obligations and outlays from this authority in 1976, transition quarter, and 1977 are funded from carryover balances.

As chart Q–1 and table Q–1 indicate, total Federal outlays being directed to environmental programs have been increasing significantly. Pollution control and abatement activities, including construction grants, represent the largest category of programs while understanding, describing and predicting, and protection and enhancement rank second and third, respectively, in size of programs.

Federal expenditures can occur either as direct outlays by a Federal agency (funding of in-house activities) or as a transfer (grants) to State or local governments or to the private sector. The distribution of 1977 Federal outlays for environmental programs according to direct or transfer spending is summarized below. It should be noted that State and local governments have been receiving increasingly greater amounts of financial assistance through transfer payments from the Federal Government.

1977 FEDERAL OUTLAYS FOR ENVIRONMENTAL PROGRAMS

[In millions of dollars]

	Outlays	
	Direct	*Transfer*
Enhancement	858.9	468.1
Understanding, describing and predicting	1,524.8	(1)
Pollution abatement (excluding construction grants)	1,604.3	305.8
Construction grants	(1)	3,913.0
Total	3,988.0	4,686.9

[1] Not applicable.

POLLUTION CONTROL AND ABATEMENT

Pollution control and abatement expenditures, including construction grant funds, represent 67% of total Federal outlays on the environment. These expenditures are directed toward cleaning up the environment and preventing further deterioration. Outlays for 1977 are estimated at $5,823.1 million. Principal activities funded include actions necessary to reduce pollution from Federal facilities; the establishment and enforcement of standards; research and development of new control technology; and the identification of pollutants, their sources, and their impact on health.

Two other types of pollution control and abatement activities are also funded. A major Federal grants program provides substantial financial assistance to State and local governments to establish and develop pollution control programs, and a smaller grants program to fund manpower development and training activities. Legislation will be proposed which provides a basis for formulating a multiyear program, commencing in 1978, for the construction of wastewater treatment plants. The legislation strikes a more appropriate balance between Federal and non-Federal responsibilities in meeting the goals of the FWPCA.

In table Q–2, budget authority and outlays for pollution control and abatement activities are presented by function. Federal expenditures for these programs are estimated to reach $5,823.1 million in 1977, representing an increase of 30% over 1976 outlays of $4,467.2 million.

Table Q–2. POLLUTION CONTROL AND ABATEMENT ACTIVITIES—BY FUNCTION (in millions of dollars)

Activity	1975 actual	1976 estimate	TQ estimate	1977 estimate
BUDGET AUTHORITY				
Financial aid to State, interstate, and local governments[1]	8,077.3	363.9	43.7	306.3
Research and development	710.9	707.9	177.3	716.9
Standard setting and enforcement	354.3	392.0	119.4	433.4
Reduce pollution from Federal facilities	367.1	426.4	58.6	474.3
Manpower development	11.8	17.4	1.7	7.0
Other	91.5	109.5	24.8	106.8
Total	9,612.9	2,017.1	425.5	2,044.7
OUTLAYS				
Financial aid to State, interstate, and local governments[1]	2,189.0	2,718.6	706.0	4,143.7
Research and development	569.6	740.5	180.5	743.0
Standard setting and enforcement	368.8	404.7	133.4	377.5
Reduce pollution from Federal facilities	334.2	475.0	76.1	441.8
Manpower development	14.7	14.3	1.1	8.6
Other	94.5	114.1	23.1	108.5
Total	3,570.8	4,467.2	1,120.2	5,823.1

[1] Includes but is not limited to grants under the Water Pollution Control Act Amendments of 1972 which provided $18 billion in contract authority to EPA. Obligations and outlays from this authority in 1976, transition quarter, and 1977 are funded from carryover balances.

Activities involved.—*Financial aid.*—Federal outlays for 1977 in the financial aid category are estimated at $4,143.7 million. Of this total, $3,913.0 million will be directed toward the construction of sewage treatment facilities. These federally funded grants cover 75% of the total eligible costs of these projects. The remainder of these grant funds are utilized in funding the air and water pollution control programs of State, areawide and local agencies. Specifically, these funds—$231 million—will be used to support objectives such as the development of the national primary and secondary ambient air quality monitoring systems, emission inventories, the development of effective and enforceable standards, and the development of transportation control and air pollution emergency plans.

The Environmental Protection Agency (EPA), the Department of Housing and Urban Development (HUD), and the Department of Commerce (DOC) respectively are the agencies most active in supporting the sewage treatment facilities construction grants program while EPA plays a leading role in funding the planning and agency support grants.

Research, development, and demonstration.—Federal outlays on research and development for pollution control and abatement are expected to reach $743 million in 1977.

These outlays cover two types of research and development activities: primary, where pollution control and abatement is the sole objective; and secondary, where pollution control and abatement activities are not the principal goal but rather represent an auxiliary benefit from research having some other primary purpose.

Research and development programs, by their nature, involve a variety of separately identifiable activities. In the abatement and control of pollutants, the sequential development of research and development programs leads first to the identification of pollutants and their sources, then to an assessment of their impact on health and the environment in general, next to development of control technologies, and, finally to systems and procedures for monitoring both point source emissions and ambient quality of air and water.

Once it is determined that a specific pollutant has an adverse impact on man or the environment, efforts need to be directed toward initiation of programs that will determine the actual adverse health effects of the pollutant. Such programs seek to determine at what level pollutants become hazardous and establish realistic exposure limits. These steps are necessary in order to establish a logical framework within which decisions can be made relative to the development of appropriate abatement strategies and control technologies. The primary mission of health effects research and development programs is to develop a sufficient quantitative data base on chemical, physical, and biological environmental factors affecting human health to initiate a scientific strategy for control measures.

Having established a basis for the development of control technologies, research and development efforts can then be directed toward processes and procedures to curb and/or eliminate undesirable or hazardous pollutants. Generally, two methods of control are available—utilization of retrofit devices which remove emitted pollutants, and the reduction of the initial generation of pollutants through changes in production methods.

The final stage of research and development activities in the pollution control and abatement category involves efforts to develop techniques for monitoring the emission of pollutants. These programs are concerned with the improvement in technology—both in devices and techniques—for monitoring point source emissions as well as the ambient quality of air and water. Federal research and development efforts in this area have generally been concentrated on improving monitoring techniques and sampling procedures; whereas, the development of monitoring equipment has been concentrated in the private sector.

Examples of pollution abatement related research and development activities in 1977 will include:

1. Turbidity studies and sediment and waste runoff control measures designed to improve water quality. These programs result in safer water supplies for human use and an improved environment for marine life.
2. Field investigation programs, air pollution modeling and epidemiological and toxicological studies relating to air quality research and development. These activities are directed toward measurement of the effects of air pollutants on man and animals.
3. Demonstration of stack gas technology designed to effect transition to clean fuels and to promote energy conservation.

Standard setting and enforcement.—Twelve Federal agencies reported 1977 outlays of $377.5 million. Primary emphasis, in terms of program funding in this area, is placed on Federal support of monitoring, surveillance, standard setting and enforcement. Monitoring programs are those that measure discharged pollutants from point sources while surveillance refers to testing of ambient levels of pollution. These monitoring and surveillance data provide a basis for Federal efforts to develop and review new and/or existing standards, and establish effective enforcement programs.

Those agencies funding major programs in this area are EPA, NRC, DOT, ERDA, and the Corps of Engineers. Spending is concentrated on monitoring, standard setting and enforcement, technical support and surveillance.

Pollution abatement from Federal facilities.—Federal agencies also have active programs to abate pollution from their own facilities in order to be in compliance with Federal laws and the substantive requirements of the State and local governments in which Federal facilities are located.[1]

In 1977, Federal agencies reporting expenditures on environmental programs estimate spending of $441.8 million on abatement of pollutants from their facilities. Outlays under this category of activity fund remedial actions, process changes, and fuel switching to abate emission of pollutants. Related administrative costs are also included.

About 80% ($355 million) of Federal outlays in this area of activity occur in remedial action programs. These programs involve the installation of retrofit devices on existing facilities or facilities under construction. Retrofit devices treat pollution only after generation and are separately identifiable abatement equipment such as electrostatic precipitators or dust collectors.

Expenditures on process changes are defined as those outlays incurred due to the incorporation of pollution abatement processes within an existing system. The process change approach to pollution abatement reduces or eliminates pollution by modifying the procedures which generate pollutants. Process changes may take the form of material substitution, reuse of waste or water, and equipment or production process alternatives. $29 million in 1977 Federal outlays are directed to this program.

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[1] Outlays are for facilities or properties which are either owned or leased by the Federal Government and reflect expenditures on existing facilities, additions to existing facilities or new facilities.

While remedial action continues to command the major portion of outlays in this category, a shift toward larger relative outlays in process changes can be expected as standards become more clearly defined, technological capabilities expand, and older facilities are replaced.

In addition to the programs mentioned above, Federal outlays of $52 million are required to support incremental costs of fuel switching and operating costs. Fuel switching costs are those incremental costs associated with the increased fuel or power costs incurred from using low-sulfur or low-polluting fuels or from the operation of remedial equipment or process change procedures. Outlays for operating costs include those expenditures incurred due to cleaning, servicing, and monitoring remedial action or process change devices. Expenditures for these two activities represent 12% of Federal outlays for the abatement of pollution from Federal facilities.

Manpower development.—In 1977, Federal outlays of $8.6 million will be directed toward funding various manpower development programs which relate to improving pollution abatement efforts. These Federal funds are used to support such activities as inhouse training, fellowships, and training grants.

Pollution abatement by media.—Table Q–3 presents Federal outlays and obligations for pollution control and abatement categorized by media in contrast to the functional distribution shown in table Q–2. Outlays and obligations for water programs receive the largest share of Federal funds because of the large grant and loan programs which fund the construction of waste treatment facilities. It should also be noted that only funding for those activities that directly lead to pollution abatement are included in table Q–3. Programs that may ultimately lead to abatement and control of pollutants but which do not have abatement as their primary objective are excluded.

Examples of activities which are excluded from table Q–3 are:

- Pest management and control programs developed in the Department of Agriculture and designed to control pests by means other than the use of chemical pesticides.
- Urban Mass Transit Authority programs in the Department of Transportation that work to improve transit operations and rapid rail vehicles, thereby reducing pollution as a secondary benefit.
- Development of associated air and water quality monitoring instruments by NASA. These instruments were developed for use in advanced spacecrafts but can also be utilized in more generalized pollution control efforts.

Table Q-3. POLLUTION CONTROL AND ABATEMENT ACTIVITIES—BY MEDIA OR POLLUTANT (in millions of dollars)

	Outlays 1975 actual	Obligations 1975 actual	1976 estimate	TQ estimate	1977 estimate
Media polluted:					
Water	2,658.8	5,179.2	5,491.9	1,193.3	6,979.7
Construction grants or loans	2,100.6	4,407.8	4,717.7	1,048.6	6,294.3
Other	558.2	771.4	774.2	144.7	685.4
Air	274.3	347.8	334.4	83.1	356.5
Land	52.7	57.5	66.0	18.3	107.5
Other (e.g., living things, materials)	400.7	433.6	573.5	165.8	463.6
Multimedia (i.e., more than one of above)	82.5	85.0	116.6	31.7	117.5
Total	3,469.0	6,103.1	6,582.4	1,492.2	8,024.8
Selected pollutants:[1]					
Solid wastes	152.3	173.5	196.1	59.6	194.5
Pesticides	56.8	58.6	69.2	20.5	102.5
Radiation	164.9	[illegible]	188.9	51.6	231.0
Noise	58.4	49.6	77.7	14.5	53.2

[1] Funds for selected pollutants are included in "media" distribution above.

Pollution control and abatement programs in air and water (excluding construction grants) are primarily directed toward research and development activities, grants to States and local control agencies, and such direct Federal operations as monitoring and enforcement. Most of the activities relating to the abatement of pollutants on land are concentrated in the research and development area and encompass such projects as studies of acid mine drainage, nutrients, pesticides and solid waste disposal. Federal activities concerned with the selected pollutants shown in table Q-3 are, for the most part, directed toward research in effects, control technology, standard setting and enforcement.

Pollution control and abatement by agency.—Federal budget authority and outlays on pollution control and abatement are presented by agency in table Q-4. Twenty agencies reported budget authority and outlays for this category of environmental expenditures in 1977.

Table Q-4. POLLUTION CONTROL AND ABATEMENT ACTIVITIES—BY AGENCY (in millions of dollars)

Agency	1975 actual	1976 estimate	TQ estimate	1977 estimate
BUDGET AUTHORITY				
Environmental Protection Agency	8,516.5	771.5	188.6	718.2
Defense—Military	346.9	423.1	47.7	469.9
Energy Research and Development Administration	175.5	199.6	61.4	230.7
Agriculture	116.9	144.2	41.1	129.5
Transportation	88.6	99.3	18.3	98.7
Housing and Urban Development	83.4	93.4	0.9	104.6
National Aeronautics and Space Administration	83.9	74.9	23.4	76.8
Interior	54.3	54.3	11.8	56.2
Commerce	58.9	63.1	15.5	56.8
Defense—Civil	37.3	36.0	7.7	36.0
Nuclear Regulatory Commission	24.3	24.7	6.2	31.5
Other agencies	26.4	33.0	2.9	35.8
Total	**9,612.9**	**2,017.1**	**425.5**	**2,044.7**
OUTLAYS				
Environmental Protection Agency	2,530.5	3,192.6	844.0	4,500.0
Defense—Military	318.1	458.9	65.3	436.0
Energy Research and Development Administration	159.0	200.4	51.3	224.9
Agriculture	142.5	167.7	57.6	195.3
Transportation	79.9	94.8	15.3	92.8
Housing and Urban Development	79.2	73.8	20.0	83.6
National Aeronautics and Space Administration	75.3	83.0	22.0	85.0
Interior	52.6	52.2	12.0	52.8
Commerce	52.1	54.9	13.5	53.0
Defense—Civil	37.3	36.0	7.2	36.0
Nuclear Regulatory Commission	23.1	23.8	6.0	30.2
Other agencies	21.2	29.1	6.0	33.5
Total	**3,570.8**	**4,467.2**	**1,120.2**	**5,823.1**

Main agency activities.—The *Environmental Protection Agency* programs represent over 77% ($4,500.0 million) of the total expected outlays in this category primarily because of its sewage treatment grant program. Outlays by EPA will increase by more than 40% over 1976 outlay levels of $3,192.6 million.

The operating budget of EPA, which excludes construction grants, highlights various other programs conducted by this agency. Research and development programs ($280 million) will account for some 38% of EPA's operating budget, with major program support going to sources and effects, control technology, and health effects activities.

In its abatement and control operations, EPA devotes much of its effort to standard setting and enforcement, technical support, and grants for these activities. In 1977, outlays are expected to reach $305 million. These funds support a wide variety of programs, ranging from enforcement of standards to the issuance of permits and the provision of assistance in assessing the impacts of air, water, solid waste, noise, hazardous materials, and pesticides pollution.

In the *Department of Defense—Military*, research programs leading to reduction of pollution from its facilities are continuing. In 1977, outlays are expected to reach $436.0 million, with the major portion of these expenditures being directed toward remedial actions. Abatement and control outlays on environmental programs by the Corps of Engineers (*DOD—Civil*) have primarily been used in improving and expanding knowledge relating to water quality and management. Programs include assessment of the environmental impact of pollutants on fish, wildlife, and aquatic systems, as well as on man. The Corps has expanded its activities relating to the governing of the discharge of dredged or fill material into navigable waters or the ocean and the implementing of the "Endangered Species Act."

The Energy Research and Development Administration will increase its pollution and abatement control outlays by more than 10% from $200.4 million in 1976 to $224.9 million in 1977. ERDA will concentrate its efforts in abatement and control operations, research and development, and remedial action. Specifically, ERDA is expanding efforts in: (1) research and development of pilot plant programs to convert coal to fuel gas with less pollution, (2) health research to determine human thresholds of exposure to hazardous agents, and (3) environmental research on offshore powerplant siting and oil drilling and exploration. Additionally, programs are being continued in ecological effects of thermal effluents, alternative methods of cooling water disposal, and the toxicity of chemicals added to prevent fouling of cooling systems.

Problems of agriculture-related pollution are being researched by the *Department of Agriculture*. Continued emphasis is being placed on the development of methods to abate pollution from the production and processing of agricultural products; the recycling of animal wastes; and preventing degradation of air, water, and soil by agricultural chemicals. Programs relating to sediment control and agricultural runoff are being maintained as part of water quality and management programs. In addition, the Farmers Home Administration provides funding for construction of facilities in rural areas to improve the collection, processing, and disposal of wastes.

The Department of Transportation will expend $92.8 million for pollution control and abatement programs in 1977. Major programs in noise control are being funded by DOT. The Federal Aviation Agency is concentrating its efforts on the demonstration of technical, operational, and economic feasibility of reducing noise, sonic boom, and pollution generated by aircraft. The Urban Mass Transportation Administration continues to support programs that have as their objective a reduction in emission of hydrocarbon and carbon monoxide and the conservation of energy used by mass transportation systems. The Coast Guard is funding programs to improve its ability to investigate oil spills and to initiate preventive and cleanup actions in order to alleviate the adverse environmental impacts of such pollution.

Environmental programs in the *Department of Housing and Urban Development* are continuing in the areas of sewage treatment grants and public facilities loans. The Department also conducts research and development programs providing for the development and application of improved control technology in the areas of solid and liquid waste management and noise abatement.

The National Aeronautics and Space Administration (NASA) plans to spend $85.0 million in outlays in 1977 for pollution control and abatement research and development programs. For example, NASA is conducting programs to reduce and control aircraft noise and emission pollutants. Through the use of satellites, NASA is monitoring atmospheric pollution. For example, a pollution monitoring satellite, the Stratospheric Aerosol and Gas Experiment (SAGE), is now under development to provide data on the concentrations and distributions of aerosols in the ozone layer of the upper atmosphere.

UNDERSTANDING, DESCRIBING, AND PREDICTING THE ENVIRONMENT

Fourteen Federal agencies will spend $1,524.8 million in 1977 to describe the physical characteristics of the environment, to increase understanding of the environment, and to predict environmental conditions. This is a 4% increase over estimated 1976 expenditures of $1,467.5 million. Programs in these areas protect and enhance the environment as well as control pollution.

As table Q–5 indicates, almost half of these expenditures will support environmental observation and measurement efforts that help describe and predict weather, ocean conditions, and earthquakes. Also included are efforts to investigate and report on climate fluctuations and the funding of weather satellite programs to provide improved environmental warning services.

Locating and describing natural resources account for $394.1 million in 1977 expenditures. Activities such as the Earth Resources Survey Program are increasing man's understanding of existing natural resource systems and identifying, evaluating, and monitoring new natural resources.

Other expenditures will be for further ecological research, for physical environmental survey activities, and for aerial reconnaissance of tropical cyclones and winter storms. There also are expenditures for earthquake engineering and polar research projects.

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Table Q-5. UNDERSTANDING, DESCRIBING, AND PREDICTING THE ENVIRONMENT—BY FUNCTION (in millions of dollars)

Activity	1975 actual	1976 estimate	TQ estimate	1977 estimate
BUDGET AUTHORITY				
Observe and predict weather, ocean conditions, and disturbances:				
Research and development	196.8	212.3	62.7	230.8
Operations	404.0	471.4	111.9	507.5
Locating and describing natural resources:				
Research and development	201.5	211.4	53.1	214.7
Operations	177.4	193.7	47.6	195.7
Physical environmental surveys:				
Research and development	13.6	12.6	3.1	14.9
Operations	138.1	135.6	34.2	152.3
Weather modification activities	22.3	17.5	7.8	18.4
Research on environmental impact on man	67.3	75.4	16.7	94.9
Ecological and other basic environmental research	131.4	156.6	38.2	177.9
Total	**1,352.4**	**1,486.5**	**375.3**	**1,607.1**
OUTLAYS				
Observe and predict weather, ocean conditions, and disturbances:				
Research and development	192.9	212.3	67.2	232.1
Operations	402.2	449.0	106.6	469.0
Locating and describing natural resources:				
Research and development	179.8	212.2	52.2	204.4
Operations	170.9	197.7	50.1	189.7
Physical environmental surveys:				
Research and development	14.7	13.5	3.1	13.9
Operations	130.7	131.3	33.3	140.5
Weather modification activities	23.5	18.0	10.7	20.2
Research on environmental impact on man	56.8	77.3	17.5	86.3
Ecological and other basic environmental research	124.9	156.2	42.2	168.7
Total	**1,296.4**	**1,467.5**	**382.9**	**1,524.8**

Table Q–6 shows the distribution of total budget authority and outlays by the major agencies involved.

Table Q–6. **UNDERSTANDING, DESCRIBING, AND PREDICTING THE ENVIRONMENT—BY AGENCY** (in millions of dollars)

Agency	1975 actual	1976 estimate	TQ estimate	1977 estimate
BUDGET AUTHORITY				
Commerce	371.7	429.1	107.6	470.7
Interior	234.3	254.5	65.0	248.3
Defense—Military	204.3	215.0	53.6	235.4
National Science Foundation	128.6	141.6	39.0	155.9
National Aeronautics and Space Administration	162.7	166.6	42.6	190.2
Agriculture	135.0	146.1	34.8	146.7
Energy Research and Development Administration	32.1	41.9	10.6	50.2
Health, Education, and Welfare	35.7	34.6	7.8	46.7
Defense—Civil	18.0	17.9	4.4	19.7
Transportation	13.6	15.3	3.8	17.8
Smithsonian Institution	11.4	12.7	3.3	13.3
Other	5.0	11.2	2.8	12.2
Total	**1,352.4**	**1,486.5**	**375.3**	**1,607.1**
OUTLAYS				
Commerce	371.5	409.4	107.7	429.2
Interior	212.0	262.3	67.8	239.8
Defense—Military	200.2	204.2	47.4	222.8
National Science Foundation	126.5	139.6	46.9	153.2
National Aeronautics and Space Administration	149.5	167.7	42.3	186.9
Agriculture	132.9	150.2	37.7	143.1
Energy Research and Development Administration	30.1	39.9	10.2	48.2
Health, Education, and Welfare	26.0	37.2	8.7	39.3
Defense—Civil	18.0	17.9	4.4	19.7
Transportation	13.3	15.4	3.8	17.7
Smithsonian Institution	11.6	13.0	3.4	13.1
Other	4.8	10.7	2.6	11.8
Total	**1,296.4**	**1,467.5**	**382.9**	**1,524.8**

Agencies involved.—*The National Science Foundation* plans to spend $153.2 million in 1977 in support of research to increase the Nation's knowledge of the environment. Particular emphasis will be on increasing the capacity for more accurate and long-range weather forecasts and for accurate assessments of their impact on human affairs. Other efforts will be directed toward finding ways to minimize the adverse effects of extracting and processing natural resources and to expand environmentally acceptable ways of recovering, converting, storing, and distributing energy resources. Major programs include the Global Atmospheric Research Program, the International Decade of Ocean Exploration, and the Climate Dynamics Program.

The Department of Commerce, primarily through the National Oceanic and Atmospheric Administration (NOAA), conducts environmental monitoring and prediction activities, surveys for mapping and charting, data storage and dissemination, and related research. NOAA plans to spend $367 million on such environmental observation and measurement activities as observing, predicting, and reporting on climatic fluctuations. NOAA hopes to reduce loss of life and property from recurring natural disasters through their weather warning and weather reconnaissance efforts. Further procurement and use of satellite systems accounts for much of NOAA's 1977 expenditure increase. Other activities that will increase in 1977 are efforts to analyze man's impact on marine ecosystems. For example, the effect of offshore waste disposal on aquatic life will be investigated.

The Department of Interior through several of its bureaus will spend $239.8 million in 1977 for its efforts to understand, describe, and predict the environment. Most of this money (90%) will be spent by the Geological Survey to continue programs such as urban pilot area studies that provide land and water resource and hazard data in order to improve the basis for urban planning; topographic mapping to describe the physical environment; and resource evaluation of the Outer Continental Shelf.

The Bureau of Reclamation performs various ecological research programs; for example, it studies the effects of water projects on the ecology of local areas or river basins, and analyzes the effects of vegetation management on wildlife along the Lower Colorado River. Through their cloud seeding efforts, the Bureau has found that precipitation can be increased 10% to 30% annually under certain conditions with only minor and transitory environmental impacts. The Bureau hopes that these research activities will be utilized to manage the amount and use of precipitation as part of the Nation's total water resources program.

The National Aeronautics and Space Administration (NASA) plans to spend $87 million in 1977 on research and development in environmental observation and measurement. These activities include (1) developing the capacity to make accurate short- and long-term weather predictions through use of satellites; (2) improving atmospheric temperature sounding and wind measurements through the all-weather atmospheric sounding satellite; and (3) using temperature soundings for earlier detections of tornados.

NASA will also be spending $91 million on its efforts to develop new capabilities to locate and describe natural resources. The Earth Resources Survey Program, by utilizing satellites, is conducting experiments throughout the world in taking inventories of natural resources and monitoring their changes over time. Research and technology activities underway involve improved approaches to detection and utilization of Earth resources information, such as expansion of efforts into the thermal infrared region through the development of the Thematic Mapper.

The Department of Defense—Military plans to spend 70% of its outlays in this category for activities in environmental observation and measurement to describe and predict weather, ocean conditions, and disturbances important to military operations. The Corps of Engineers *(DOD—Civil)* is spending 20% of its outlays in this category on other observation efforts. Research is continuing in oceanographic instrumentation development. The Corps also conducts studies of terrestrial and marine ecologicial systems to determine the impact of engineering works. These studies are designed to develop technology and methodology for minimizing the impact of these projects on the ecosystem and environment, while at the same time permitting national economic growth.

The Soil Conservation Service (SCS) in the *Department of Agriculture* will spend $117 million during 1977 on programs that locate and describe natural resources. Specifically, SCS conducts soil, snow, and river basin surveys, and makes water-supply forecasts. The Forest Service will spend $22 million in the same period, with most expenditures used for environmental research. The Forest Service is attempting to better understand ecosystems so that management practices can lead to improved productivity and quality of the environment. Other research efforts attempt to solve the complex problems concerning forests and related ecosystems and their interface with urban areas.

The Agricultural Research Service (ARS) also conducts research in this area. By utilizing remote sensing, ARS is devising improved capabilities for (1) determining soil characteristics and updating soil maps and watershed measurements; and (2) assessing environmental and ecological conditions and interactions between man and the environment.

ENVIRONMENTAL PROTECTION AND ENHANCEMENT

In 1977, 10 Federal agencies are expected to spend $1.3 billion to protect and enhance the environment. This is a 7% increase over 1976 outlays. As table Q-7 shows, 35% of these expenditures are Federal grants to State and local governments and the balance are for direct Federal activities.

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Table Q-7. ENVIRONMENTAL PROTECTION AND ENHANCEMENT ACTIVITIES—BY FUNCTION (in millions of dollars)

Activities	1975 actual	1976 estimate	TQ estimate	1977 estimate
BUDGET AUTHORITY				
Financial aid to State and local government:				
Purchase, development and operations:				
City recreation	151.6	143.8	8.0	161.8
Preserve unique areas	.1	2.0	.3	5.4
Noncity general recreation	156.1	155.7	37.8	156.1
Sport fish and wildlife	97.8	110.5	25.1	119.9
Historic preservation and rehabilitation	20.2	20.2	4.7	10.2
Other State local aid	46.9	56.9	1.1	75.9
Subtotal	472.7	489.1	77.0	529.3
Direct Federal activities:				
Purchase, development and operations:				
City recreation	154.5	129.1	33.7	125.4
Preserve unique areas	155.2	221.8	63.7	250.1
Noncity general recreation	188.4	191.6	63.2	188.4
Sport fish and wildlife	137.8	143.8	34.2	160.2
Historic preservation and rehabilitation	65.2	44.6	12.7	43.5
Other direct activities	74.4	80.9	12.4	84.5
Subtotal	775.5	811.8	219.9	852.1
Total	**1,248.2**	**1,300.9**	**296.9**	**1,381.4**
OUTLAYS				
Financial aid to State and local government:				
Purchase, development and operations:				
City recreation	110.1	122.1	31.6	126.2
Preserve unique areas	.1	2.0	.3	3.6
Noncity general recreation	150.9	151.4	37.4	149.7
Sport fish and wildlife	89.9	101.7	24.6	105.9
Historic preservation and rehabilitation	11.3	14.0	4.7	10.6
Other State local aid	40.8	55.9	9.6	72.1
Subtotal	403.1	447.1	108.2	468.1
Direct Federal activities:				
Purchase, development and operations:				
City recreation	145.2	141.3	35.0	128.9
Preserve unique areas	163.6	226.4	61.8	269.5
Noncity general recreation	189.3	197.2	62.9	203.7
Sport fish and wildlife	127.8	140.6	35.8	162.6
Historic preservation and rehabilitation	60.5	46.3	13.1	49.5
Other direct activities	39.0	43.7	11.7	44.7
Subtotal	725.4	795.5	220.3	858.9
Total	**1,128.5**	**1,242.6**	**328.5**	**1,327.0**

The major activities in this category are:

- City recreation projects which establish or develop parks and recreational facilities in urban areas.
- Preservation of unique natural areas and protection of endangered species including national parks, monuments, scenic rivers, trails, wildernesses, seashores, and refuges for endangered species.
- General recreation projects outside of cities—including expenditures for national recreation areas, recreation programs in national forests, and recreation sites at Federal water projects.
- Management of sport fish and wildlife at national wildlife refuges, national fish hatcheries, and other similar projects.
- Historic preservation and rehabilitation, including national historic sites, military parks, and other federally assisted historic preservation and rehabilitation projects.

These enhancement and protection activities are categorized in table Q–7 as direct Federal spending or as grants to States and local governments for these activities. Table Q–8 lists the departments and agencies making these expenditures.

Table Q–8. ENVIRONMENTAL PROTECTION AND ENHANCEMENT—BY AGENCY (in millions of dollars)

Agency	1975 actual	1976 estimate	TQ estimate	1977 estimate
BUDGET AUTHORITY				
Interior	875.9	908.2	229.2	941.7
Housing and Urban Development	136.0	150.3	....	182.0
Agriculture	93.0	102.0	38.3	100.6
Defense—Civil	77.3	77.8	19.5	85.6
Commerce	38.6	50.3	6.8	58.2
Tennessee Valley Authority	4.3	4.7	1.6	4.8
Other agencies	23.1	7.6	1.5	8.5
Total	**1,248.2**	**1,300.9**	**296.9**	**1,381.4**
OUTLAYS				
Interior	797.9	861.8	226.7	917.6
Housing and Urban Development	104.9	122.4	34.5	160.1
Agriculture	87.4	98.7	36.6	97.7
Defense—Civil	72.8	82.3	20.6	90.5
Commerce	38.3	48.9	6.8	48.9
Tennessee Valley Authority	4.7	4.5	1.6	4.4
Other agencies	22.5	24.0	1.7	7.8
Total	**1,128.5**	**1,242.6**	**328.5**	**1,327.0**

Agencies involved.—*The Department of the Interior* through the Fish and Wildlife Service administers 89 hatcheries and 379 units in the National Wildlife Refuge System encompassing 33.5 million acres. The Service also manages 353 wildlife refuges with 9.8 million acres for migratory birds. In 1977, $132 million will be spent for direct Federal activities and $90 million will be granted to State and local governments for fish and wildlife restoration, management and research.

The Bureau of Outdoor Recreation promotes coordination of outdoor recreation programs. It also administers the Land and Water Conservation Fund which provides grants for planning, acquisition, and development of State and local recreation areas and provides funds for Federal purchases of nationally important lands. Outlays for these programs in 1977 will be $336 million, of which $158 million will be for grants to State and local governments and $178 million for direct Federal activities.

The National Park Service will spend $340 million for all activities of the National Park System. These funds will be for operation, maintenance, general administration, planning and construction of facilities, and restoration or rehabilitation of historic areas within the National Park System. States and local governments will receive approximately $10 million in matching funds for acquiring historic properties to help preserve them for future generations.

The Department of Housing and Urban Development estimates outlays of $160.1 million for financial aid to States and local governments for environmental protection and enhancement activities. One such program in HUD is the Community Development Block Grant Program which will fund, at the grant recipient's discretion, the protection and improvement of properties having scenic, recreation, conservation and/or historic value. Grants for open space can also be obtained.

The Department of Agriculture carries out a variety of enhancement activities, particularly through the Forest Service and the Soil Conservation Service. The Forest Service will spend $67 million in 1977 primarily for direct Federal activities including administration of concession and recreation special use permits, enhancement of wildlife and fish habitat, and improvement and protection of rare and endangered species habitats on National Forest lands.

The Soil Conservation Service will spend $29 million for protection and enhancement activities—primarily for recreation area improvement.

In the *Department of Defense—Civil*, the Corps of Engineers will spend $90.5 million to protect and enhance lands and shorelines within its jurisdiction. For example, in the Forest Management Program, the forest resources at civil works projects are managed to increase their value for recreation and wildlife habitat and to promote natural ecological conditions by following accepted conservation practices. Activities of this nature are also funded by the Fish and Wildlife Management Program and the Lakeshore Management Program.

The National Oceanic and Atmospheric Administration in the *Department of Commerce* will be spending $16 million for improving the management of the Nation's coastal zones through joint projects with the States. For example, the onshore impact of oil and gas facilities in coastal areas will be studied and States will be assisted in establishing a national system of estuarine sanctuaries for research and educational purposes. NOAA will also spend $33 million on other protection and enhancement projects. For example, programs conserving marine resources which include marine mammal conservation and endangered species research will be undertaken.

RESEARCH AND DEVELOPMENT

A description of funding for environmental research and development programs appears elsewhere in this analysis. However, because research and development expenditures occur in more than one category of activity, these expenditures have been summarized in table Q-9. Total Federal funding for research and development programs related to environmental improvement will reach an estimated $1,468.6 million in 1977. This represents an increase of 26% over actual 1975 outlays of $1,162.2 million and an increase of 3% over 1976 funding levels of $1,430 million.

Federal funding for environmental research and development programs are almost evenly distributed between pollution control and abatement activities and programs relating to understanding, describing, and predicting the environment. Research and development expenditures for environmental protection and enhancement programs, to the extent that they exist, are not included in table Q-9 because these outlays are not reported separately.

Table Q-9. ENVIRONMENTAL RESEARCH AND DEVELOPMENT ACTIVITIES

(In millions of dollars)

Category	1975 actual	1976 estimate	TQ estimate	1977 estimate
BUDGET AUTHORITY				
Pollution control and abatement [1]	710.9	707.9	177.3	716.9
Understanding, describing, and predicting	632.9	685.8	181.6	751.6
Total	**1,343.8**	**1,393.7**	**358.9**	**1,468.5**
OUTLAYS				
Pollution control and abatement [1]	569.6	740.5	180.5	743.0
Understanding, describing, and predicting	592.6	689.5	192.9	725.6
Total	**1,162.2**	**1,430.0**	**373.4**	**1,468.6**

[1] Includes both primary and secondary research and development.

APPENDIX D. ADVISORY COMMITTEES OF THE COUNCIL ON ENVIRONMENTAL QUALITY

The Presidentially appointed Citizens' Advisory Committee on Environmental Quality is the only advisory committee reporting to the Council on Environmental Quality. As required by Executive Order 11007, the members, a brief description of its functions, and the dates of its meetings are listed below.

CITIZENS' ADVISORY COMMITTEE ON ENVIRONMENTAL QUALITY

FUNCTIONS

Established by Executive Order 11472, May 29, 1969, this committee advises the President and the Council on Environmental Quality on all aspects of environmental quality and recommends actions by federal, state, and local governments and by the private sector. The Council consults with the Committee pursuant to Section 205 of the National Environmental Policy Act (42 U.S.C. § 4345).

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Mayor Pete Wilson
San Diego, California

MEETINGS

January 16, 1976, Washington, D.C.
May 12, 1976, Washington, D.C.

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